FEBRUARY 1988

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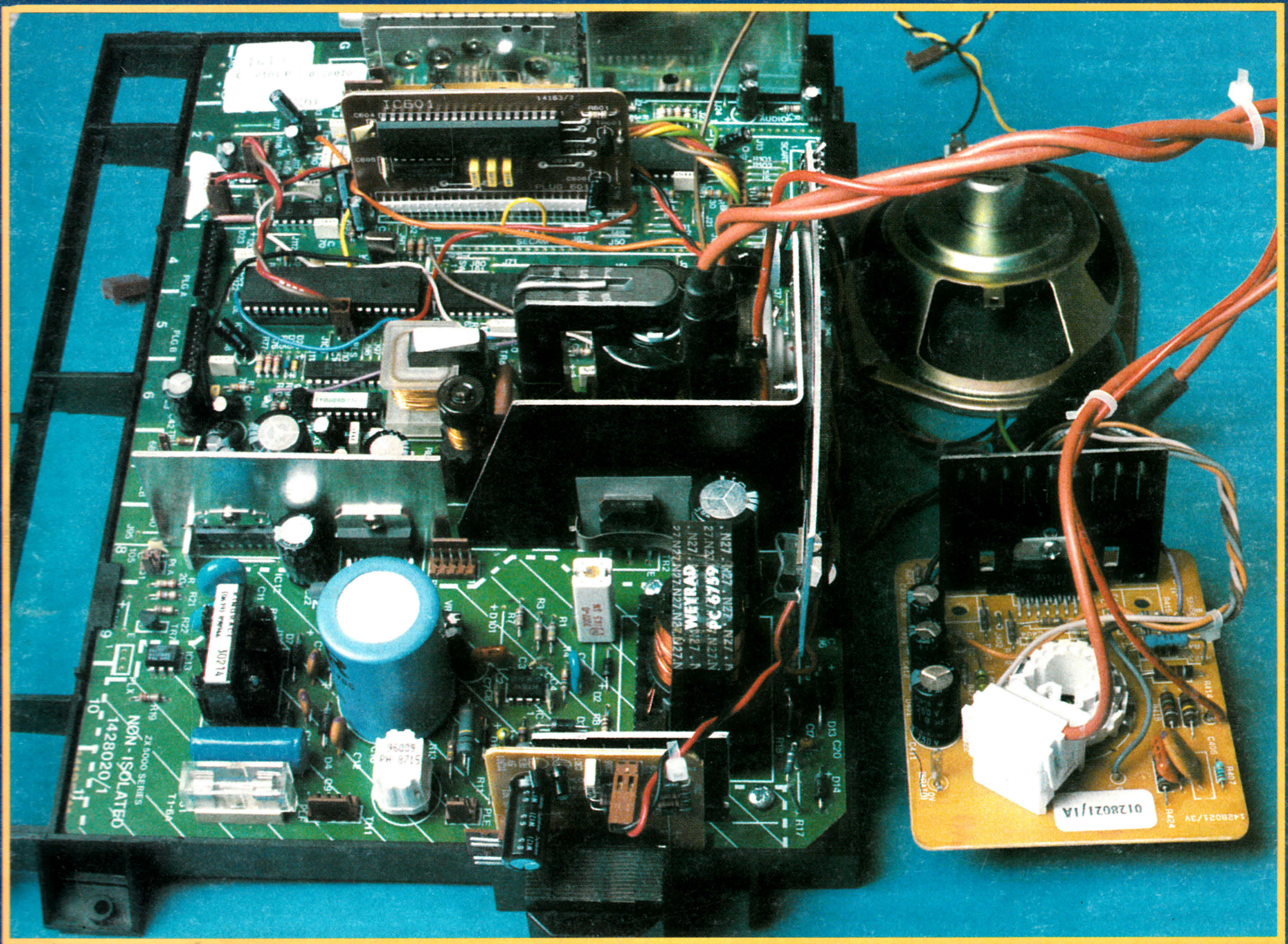
TELEVISION

SERVICING·PROJECTS·VIDEO·DEVELOPMENTS



Fidelity's Digital TV Chassis
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Helical Aerials for Band I
The Philips 3A Chassis
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MKV PAL COLOUR TEST GENERATOR FOR DOMESTIC TV & VCR.

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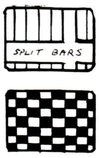

- ★ 40 different patterns and variations.
- ★ Broadcast transmission accuracy (fully interlaced sync pulses with correct picture blanking).
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- ★ Additional video output for CCTV & VCR.
- ★ Facilities for sound output.
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SPECIAL TEST REPORT 'TELEVISION' DEC. 1982

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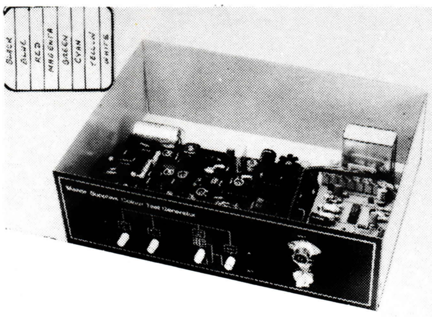

- ★ Output at UHF, applied to receiver aerial socket.
- ★ In addition to colour bars R-Y, B-Y etc.
- ★ Cross-hatch, grey scale, peak white and black level.
- ★ Push button controls, battery or mains operated.
- ★ Simple design, only five i.c.s on colour bar P.C.B.

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TELEVISION

February 1988

Vol. 38, No. 4
Issue 448

On sale January 20th

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INDEXES
Indexes to Vols. 35 and 36 are available at 80p each from the Editorial Office (address above).

QUERIES
We regret that we cannot answer technical queries over the telephone nor supply service sheets. We will endeavour to assist readers who have queries relating to articles published in *Television,* but we cannot offer advice on modifications to our published designs nor comment on alternative ways of using them. Correspondents should enclose a stamped addressed envelope.
Requests for advice on dealing with servicing problems should be directed to our Queries Service. For details see our regular feature "Service Bureau". Send to the address given above (see "correspondence").

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259 Vintage Scene: the Kinemacolor System *Chas E. Miller*
The problems with this pioneer colour film system were similar to those that affect colour TV displays.

260 Letters

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264 TV Fault Finding
Reports from Eugene Trundle, Nick Beer, Roger Burchett, Philip Blundell, Eng. Tech., Christopher Holland and Alfred Damp.

266 Teletopics
News, comment and developments.

268 Dual-Channel TV Sound Systems, Part 2 *Geoff Lewis, B.A., M.Sc.*
An account of some basic digital techniques used in processing modern stereo sound signals, including sampling and quantization, signal codes, error correction techniques and encryption systems.

273 The Fidelity ZX5000 Chassis *J. LeJeune*
A look at the techniques used in this recent chassis which employs extensive digital signal processing.

278 VCR Clinic
Reports from Christopher Holland, Alfred Damp, Philip Blundell, Eng. Tech., Roger Burchett, Steve Beeching, T.Eng. and Eugene Trundle.

282 Helical Aerials for Band I *Roger Bunney*
The Les Wallen type helical aerial has proved to be a successful means of obtaining DX-TV reception in Band I. Extensive tests were carried out during last year's SpE season.

283 The Philips 3A Chassis *Harold Peters*
The current top-of-the-range Philips CTV chassis incorporates many interesting features such as multi-standard decoding, colour transient improvement and circuit control by means of microcomputer chips and an I^2C bus.

286 Back in the Groove *Les Lawry-Johns*
Les reports on some troublesome sets following his recent circulation problem.

287 VHS Fast-search Systems *George Cole*
Specifications for two recently introduced fast-search systems that employ control track coding.

288 HDTV '87 *Geoff Lewis, B.A., M.Sc.*
A report on the high-definition TV conference held in Ottawa late last year.

289 Correction
Unfortunately the last half of the phased array computer program was omitted last month.

290 Service Bureau

291 Test Case 302

OUR NEXT ISSUE DATED MARCH WILL BE PUBLISHED ON FEBRUARY 17

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TBA920(Q)	1.20
TBA950(2X)	1.08
TBA970	4.99
TBA990	1.10
TCA760	2.30
TCA270SQ	2.50
TCA800	5.95
TCA830	3.44
TCA900	2.20
TCA910	2.20
TCA940	90
TCP4621AF6	13.87
TDA440	2.20
TDA1002	1.95
TDA1003A	5.50
TDA1006A	2.50
TDA1005	3.60
TDA1010	3.30
TDA1011	4.00
TDA1035	4.70
TDA1037	2.95
TDA1044	4.37
TDA1060A	4.44
TDA1083	1.68
TDA1170S	3.00
TDA1190	3.50
TDA1190P	3.50
TDA1180	2.91
TDA1236	3.44
TDA1270	3.95
TDA1327	1.70
TDA1352B	1.60
TDA1412	95
TDA1415	1.40
TDA1470	4.67
TDA1770	5.60
TDA1908A	1.95
TDA2002	75
TDA2003	1.00
TDA2004	1.60
TDA2006	1.45
TDA2010	2.40
TDA2140	5.95
TDA2151	3.25
TDA2020	4.66
TDA2030	2.80
TDA2270	1.65
TDA1870	6.46
TDA2522	2.66
TDA2523	3.40
TDA2524	2.25
TDA2525	4.00
TDA2530	2.70
TDA2532	2.90
TDA2540	95
TDA2541	3.84
TDA2560	1.15
TDA2576A	3.75
TDA2577	4.73
TDA2578A	5.12
TDA2581	3.95
TDA2582	2.60
TDA2593	2.95
TDA2600	6.90
TDA2610	3.20
TDA2611A	2.35
TDA2640	2.90
TDA2652	7.31
TDA2653A	5.90
TDA2680	3.40
TDA2690	2.72
TDA3190	2.00
TDA3330	2.21
TDA3500	6.90
TDA3560	6.00
TDA3561A	6.66
TDA3562	8.60
TDA3571	3.75
TDA3650	3.85
TDA3651A	4.50
TDA3652	6.00
TDA3810	3.86
TDA3950	4.37
TDA4420	5.55
TDA4500	5.84
TDA4503	5.68
TDA4600	2.95
TDA4600-2D	2.95
TDA8180	4.00
TDA9503	4.21
TEA1009	1.86
TL494CN	6.57
UPC554	2.63
UPC566H	75
UPC575C2	89
UPC576H	1.90
UPC585	3.06
UPC587C2	2.34
UPC1025H	2.15
UPC1026H	90
UPC1028H	90
UPC1032H	58
UPC1042C	1.56
UPC1156H	2.45
UPC1158H	3.50
UPC1163H	2.48
UPC1167C2	2.70
UPC1168C	3.20
UPC1176C	2.53
UPC1177H	3.15
UPC1178C	4.21
UPC1180C	1.84
UPC1181H	1.00
UPC1182H	1.00
UPC1183H	2.48
UPC1185H	3.45
UPC1186H	1.60
UPC1188H	4.99
UPC1190G	1.20
UPC1198C	4.00
UPC1200V	1.18
UPC1211V	2.70
UPC1212V	1.34
UPC1215V	1.66
UPC1216V	1.20
UPC1217G	2.24
UPC1218H	1.80
UPC1223C	2.20
UPC1225H	2.00
UPC1226C	1.50
UPC1227V	1.20
UPC1230H	4.39
UPC1238	2.50
UPC1245V	1.35
UPC1277	4.81
UPC1350C	4.15
UPC1353C	4.76
UPC1365C	6.38
UPC1356C2	2.08
UPC1367	2.00
UPC1358H	1.88
UPC1360C	2.20
UPC1363C	2.16
UPC1368H2	2.15
UPC1370C2	2.58
UPC1382C	1.08
UPC1384	3.78
UPC1394C	3.07
UPC1447H	58
UPC41C	2.80
UPC577H	2.46
UPC585C	1.28
UPC1167C2	2.70
UPD553C164	20.76
UPD7519G	17.13
UPD7538C020	11.06
UPD546C107	22.28
UPD547C049	11.18
U05G	1.27
V11N	1.27
10E2	43
10VT05	8.74

SPECIAL OFFERS

Multimeter HT7000
20,000Ω/V
£10.99

Pocket Meter £7.50

Universal Triplers £4.75

Solder 500G £4.95

GOLDSTAR DISKETTES

3.5″ MF 2DD DS/DD
£8.00 per box 10

5.2″ H 2DD DS/QD
£5.66 per box 10

ALL DISKS ARE BOXED/BRANDED CERT. ERROR FREE

LIFETIME GUARANTEE

PRICES DOWN

The prices of the IC's which are underlined have been reduced to prices shown.

Many of our *transistor* prices are also reduced. Ask For List.

E.G.

BC327	0.06
BC328	0.06
BD124P	0.50
BD131	0.27
BU208A	0.70
BU326A	0.85
TIP 31C	0.24
TIP 32C	0.27
TIP 41C	0.25
TIP 112H	0.40

Post & Packing 87p + VAT up to 1 kilo weight

VALVES

30FL2	1.70
DY802	98
DY86/7	66
ECC81	1.50
ECC82	98
ECC83	1.07
ECC84	80
ECC85	98
ECC88	1.35
ECF80	1.30
ECF82	88
ECH81	1.60
ECH84	1.66
ECL80	84
ECL82	1.30
ECL86	1.99
EF80	95
EF86	2.20
EF183	99
EF184	1.09
EL90	1.75
EL34	3.50
EL84	1.05
EY86/7	68
EY500A	2.25
EZ80/81	56
GY501	1.45
GZ34	3.50
KT66	9.75
KT77	8.50
KT88 (alt type)	12.00
PC92	4.50
PC97	1.65
PCC85	85
PCC805	1.40
PCF80	1.00
PCF200	1.35
PCF800	1.38
PCF801	1.13
PCF802	1.12
PCF805	1.80
PCF808	1.63
PCH200	1.45
PCL82	1.20
PCL84	1.20
PCL805	1.09
PCL86	92
PFL200	1.86
PL36	1.87
PL81	94
PL95	2.25
6L6GT	2.30
12HG7	3.20
12BH7A	2.75
PL504	1.65
PL508	2.90
PL509/19	5.30
PY88	81
PY500A	2.30
PY800/1	69
UCH81	2.25
UCL83	1.82
UY85	1.35
PL802T	4.00
40KD6	5.30
21LU8	3.00
17DW4A	4.50
3AT2B	5.00
12BH7A	3.75

PRICES ARE DOWN AND SERVICE STILL COUNTS!!! WE TRY TO BE FAIR TO YOU THE CUSTOMER SO WE PUT SOME PRICES DOWN!!

AMSTRAD SPARES

INTEGRATED CIRCUITS

AMS4002B	13.45
AM5612 (526)	4.37
AM5620X(542)	4.87
AN6320N	2.88
BS326	7.10
CX134	6.00
CX135	4.37
HB1377U/BO8203	3.65
HD74LS130N	1.25
HSF310/3170	11.82
LA8358	3.75
LA7800402	3.75
HC1377P	1.25
HN1512FUC	10.50
HN14847FCD	14.43
HSO120P	2.97
DEC1001	8.87
DEC0005	13.10
DEC1001A	7.50
DEC3002	4.06
SN74HC240N	2.06
TC74HC00	1.68
TC74HC04	1.68
TDB2030	2.80
TDB3652	8.60
TMI41257P-15	13.50
UPC1378H	2.50
UPC5743	3.75
UPC1394C	3.75
UPD8048	0.93
Z8080PU/Z8400AP	1.70
2N7400E	10.00
7293-1951	11.92
40007-4/40008	11.25
74HCUD4P	1.87
74LP00	2.75
74LS27N	0.35
74LS32	0.90
74LS74	0.65
74LS132	3.12
DEC300IR	7.50
HA1127	8.20

TRANSISTORS

BC212	0.15
BC237	0.14
BC239/C	0.93
BC337	0.18
BC547	0.13
KD471CV	0.62
KSC945C-0	0.62
KTA1015V-BF195	0.93
KTC380	0.93
KTC732	0.93
KTC1015V	0.93
KTC2120V	0.93
KTC2229V	0.93
KTC2230	0.93
TCF850	2.00
ZTX312L	0.93
2N5496	0.53
2SC838C	0.62
2SC950V	0.93
2SC1317A	0.62
2SC1417H	0.93
2SC1573NC	1.27
2SC1815V	0.93
2SC2621	1.25
2SC2634S	0.62
2SC3156A	2.46
2SD980	1.56
2SD1159	1.25
2SD1397	2.87
2SD1398	2.46
50033	0.93

WE HAVE OTHER PRODUCTS IN OUR RANGE FOR AMSTRAD AND SPECTRUM

EXPORT ORDERS WELCOME

REMOTE HAND SETS

SAME DAY DESPATCH
FAST – FAIR – EFFICIENT SERVICE

AMSTRAD

1422292	CTV2210	**15.00**
1422187	CTV2200	**15.00**
151910	TV/VIDEO	**15.00**
1409221	CTV1409	**15.00**
151175	VCR5200	**17.00**
150583	VCR7000	**10.00**
150878	VCR9000	**10.00**

DECCA

80/100	NON TXT	US	**16.50**
80/10	NON TXT	US8511	**19.50**
101	NON TXT	US8513	**23.50**

SONY

C5	RH75T	**29.04**
C6	RH72	**22.62**
C7	RHT200	**45.00**
C9	RHT213	**45.00**

ITT

305	IR8649	**22.95**
306	IR8650	**22.95**
CVC45 RG5	VS8262	**25.00**
CVC32 RG15	VS8573	**25.00**

PLEASE NOTE THAT SOME HANDSETS ARE MANUFACTURERS ORIGINALS BUT SOME MAY BE AN ALTERNATIVE TYPE.

FIDELITY

FD09193	Txt.	32 butt.	**15.90**
FD09820	IS500	12 butt	**13.81**
FD09156	F14R	12 butt	**13.81**
FD09111	AVS	14 butt	**13.75**
FD09141	CTV14S 20R/22R/140R	4 butt.	**13.75**

THORN/FERGUSON

T723	TX9/10	NON TXT IR	**16.50**
T725	TX9	NON TXT IR	**16.50**
T731	TX9/10/100	TXT/STEREO IR	**16.50**
T732	TX10	TXT IR	**16.50**
T736	TX9/10/100	TXT IR	**16.50**
T739	TX100		**16.50**

JVC

TP843	TXT IR	**13.50**

GEC

GEC/HITACHI	9300/V4001	**9.93**
GC56520831	C1404H-C1656H	**30.00**
GCA512220	C1653	**22.00**
GCA512230	C2086H, C2087H	**28.50**
GCA510710	C2067H	**28.50**
GCA514620	C2089H, C2090H C2889H, C2290H	**21.00**
GCA510870	C2069, C2269H	**27.50**

GRUNDIG

RTP20/VRC112	TP16-21-21VHR	IR	**13.50**
RTP05/VRC138	TP8-120-120E	IR	**13.50**
RTP06/IR107N	TP160-160E	IR	**13.50**
RTP07/IR380N	TP200-300-390	IR	**13.50**
RTP400/IR401	TP400VT-500VT	IR	**13.50**
VRC204	TP12	US	**13.50**

PHILIPS

G11 IR170/843 TXT IR	**13.50**
G11 (KONIG) TXT IR8435	**22.20**
G11 (KONIG) TXT 2 FUNCTION VS8518	**18.75**
G11 (KONIG) NON TXT VS8263	**21.50**
G11 31 BUTTON 691-17181 (PHILIPS) US	**27.00**
KT3/30 (KONIG) NON TXT IR8331	**15.85**
KT3/30 (KONIG) TEXT IR8420	**17.90**
KT3/30/35/40 RC5	**25.00**

REPAIR KITS – FOIL/BUTTONS/INST.

KT3/K30	WITHOUT TEXT	**8.95**
KT3/K30	WITH TEXT	**8.95**

REMOTE CONTROL TESTER **29.94**

ORDERS FROM GOVERNMENT ESTABLISHMENTS, SCHOOLS, ETC. WELCOME ON REQUISITION.

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NEW PRC6000

Programmable Remote Control

Will operate most infra-red remote equipment TV-HiFi-UCR etc.

PRC6000

Engineers need only carry 1.

Remote ONLY

£52.95

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32611
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TELEX: 635562
GRIFFIN G
FOR P.V.

CALLERS ALWAYS WELCOME

ACCESS – VISA

EXPORT ENQUIRIES WELCOME

VIDEO SPARES

WE HAVE A LARGER RANGE LISTED UNDER SPECIFIC MANUFACTURERS IN CATALOGUE FOR THORN, SONY, HITACHI, FIDELITY, NATIONAL PANASONIC, PHILIPS.

REFURBISHED HEADS (Exchange)
Equivalents Chart in Catalogue

THORN NEW LIFE (Most VHS types)	22.95
THORN NEW LIFE (National Panasonic)	24.95

REPLACEMENT VIDEO HEADS

AKAI

VS1	3HSSV	**21.95**
VS2	3HSSV	**21.95**
VS3	3HSSV	**21.95**
VS5	3HSSV	**21.95**
VS10	3HSSV	**21.95**
VS77	3HSSV	**21.95**
VS88	3HSSV	**21.95**
VS7100	3HSSV	**21.95**
VS7200	3HSSV	**21.95**
VS9300	3HSSV	**21.95**
VS9500	3HSSV	**21.95**
VS9700	3HSSV	**21.95**
VS9800	3HSSV	**21.95**

FERGUSON

3V00	3HSSV	**21.95**
3V01	3HSSV	**21.95**
3V06	3HSSV	**21.95**
3V16	3HSSV	**21.95**
3V22	3HSSV	**21.95**
3V23	3HSSV	**21.95**
3V24	3HSSV	**21.95**
3V29	3HSSV	**21.95**
3V30	3HSSV	**21.95**
3V31	3HSSV	**21.95**
3V35	3HSSV	**21.95**
3V36	3HSSV	**21.95**
8903	3HSSV	**21.95**

HITACHI

VT6500	3HSSHA	**25.50**
VT7000	3HSSHA	**25.50**
VT8000	3HSSHA	**25.50**
VT8040	3HSSHA	**25.50**
VT8100	3HSSHA	**25.50**
VT8500	3HSSHA	**25.50**
VT8700	3HSSHA	**25.50**
VT9000E	3HSSHA	**25.50**
VT9300	3HSSHA	**25.50**
VT9500S	3HSSHA	**25.50**
VT9700	3HSSHA	**25.50**
VT9900	3HSSHA	**25.50**
VT4000	3HSSH	**25.50**
VT4200	3HSSH	**25.50**
VT5000	3HSSH	**25.50**
VT5500	3HSSH	**25.50**

ORION

VH1	3HSSN	**21.95**
VH2	3HSSN	**21.95**

JVC

HRD110	3HSSV	**21.95**
HRD111	3HSSV	**21.95**
HRD120	3HSSV	**21.95**
HRD121	3HSSV	**21.95**
HRD220	3HSSV	**21.95**
HRD225	3HSSV	**21.95**
HR2200	3HSSV	**21.95**
HR3300	3HSSV	**21.95**
HR3320	3HSSV	**21.95**
HR3330	3HSSV	**21.95**
HR3350	3HSSV	**21.95**
HR3360	3HSSV	**21.95**
HR3660	3HSSV	**21.95**
HR3860	3HSSV	**21.95**
HR4000	3HSSV	**21.95**
HR4100	3HSSV	**21.95**
HR7200	3HSSV	**21.95**
HR7600	3HSSV	**21.95**
HR7610	3HSSV	**21.95**
HR7650	3HSSV	**21.95**
HR7700	3HSSV	**21.95**

NEC

PV760	PS3BS	**23.95**
PV764	PS3BS	**23.95**
PV774	PS3BS	**23.95**
N830	3HSSV	**21.95**
N831	3HSSV	**21.95**
N832	3HSSV	**21.95**
N833	3HSSV	**21.95**
PV2300	PS3BS	**23.95**
PV2400	PS3BS	**23.95**

SONY

SLF1	PS4B2S	**29.95**
SLC5	PS3BS	**23.95**
SLC6	PS3BS	**23.95**
SLC7	PS3BS	**23.95**
SLC8	PS5B3S	**39.95**
SLC9	PS5B3S	**39.95**
SLC20	PS4B2S	**29.95**
SLC24	PS4B2S	**29.95**
SLC30	PS4B2S	**29.95**
SLC33	PS4B2S	**29.95**
SLC40	PS4B2S	**29.95**
SLT50	PS5B3S	**39.95**
SLF60	PS5B3S	**39.95**
SLK95	PS5B3S	**39.95**
SL200	PS5B3S	**39.95**
SL3000	PS3BS2	**25.00**
SL8000	PS3BS2	**25.00**
SL8080	PS3BS2	**25.00**

NATIONAL PANASONIC

NV100	3HSSU1N	**25.99**
NV230	3HSSU2N	**36.97**
NV250	3HSSU2N	**36.97**
NV270	3HSSU2N	**36.97**
NV280	3HSSU2N	**36.97**
NV300	3HSSN	**21.95**
NV322	3HSSN	**21.95**
NV330	3HSS3N	**35.99**
NV333	3HSSN	**21.95**
NV340	3HSSN	**21.95**
NV370	3HSSU1N	**25.99**
NV380	3HSSU1N	**25.99**
NV390	3HSSN	**21.95**
NV450	3HSSU2N	**36.97**
NV470	3HSSU2N	**36.97**
NV480	3HSSU2N	**36.97**
NV600	3HSS3N	**35.99**
NV777	3HSS3N	**35.99**
NV861	3HSSN	**21.95**
NV2000	3HSSN	**21.95**
NV3000	3HSSN	**21.95**
NV7000	3HSSN	**21.95**
NV7200	3HSSN	**21.95**
NV7500	3HSSN	**21.95**
NV7800	3HSSN	**21.95**
NV7850	3HSSN	**21.95**
NV8170	3HSSN	**21.95**
NV8200	3HSSN	**21.95**
NV8400	3HSSN	**21.95**
NV8600	3HSSN	**21.95**
NV8620	3HSSN	**21.95**

SHARP

110	3HSSSP	**26.95**
381	3HSSSP	**26.95**
383	3HSSSP	**26.95**
384	3HSSSP	**26.95**
385	3HSSSP	**26.95**
386	3HSSSP	**26.95**
387	3HSSSP	**26.95**
388	3HSSSP	**26.95**
481	3HSSSP	**26.95**
482	3HSSSP	**26.95**
2000	3HSSSP	**26.95**
3300	3HSSSP	**26.95**
9100	3HSSSP	**26.95**
9300	3HSSSP	**26.95**
9400	3HSSSP	**26.95**
9500	3HSSSP	**26.95**
9600	3HSSSP	**26.95**
9700	3HSSSP	**26.95**

BETA ECCENTRICITY GAUGE £55.00

TOSHIBA

V31	PS3BT	**30.00**
V33	PS3BT	**30.00**
V55	3HSSV	**21.95**
V57	3HSSV	**21.95**
V5470	PS3BS2	**25.00**
V9600	PS3BT	**30.00**

SANYO/FISHER

FVHP615	3HSSSF	**35.00**
FVHP910	3HSSSF	**35.00**

PHILIPS

DV462	3HSSU1N	**25.99**
6460	3HSSU1N	**25.99**
6520	3HSSU1N	**25.99**

GENUINE HEADS

SONY 8000UB	49.39
SONY SLC9	49.39
SONY SLC5, 6, 7	49.39
SHARP 3300/9700	56.00
TOSHIBA 9600 (upper assy)	14.50
HITACHI VT336/GEC 4004	35.62
HITACHI VT11/GEC 4100	35.62
SANYO 9300/9435/9500	53.00
SANYO 5000/4700/5400	58.00
PHILIPS V2000/V2023	64.00
PHILIPS 1700	71.00

VIDEO IDLER TYRES

	O.Dia	I.Dia	Width	
SONY	23.7	17.4	4.9	**50p**
SONY	24.2	18	5.1	**50p**
HITACHI	31.8	25	4.9	**50p**
PANASONIC	37	29	3.9	**52p**
AKAI	26	20	3.9	**50p**
JVC	39.3	32.8	3.9	**56p**
JVC	33	23.9	4	**56p**
NATPAN	31.2	25	3.1	**56p**

VIDEO PINCH ROLLERS

PANASONIC	NV7000	**3.75**
SANYO	VTC9300/VBS7000	**3.75**
SONY	C7/J7/SL17	**3.75**
JVC	TCE3V00/01/06/16/23/24	**3.75**
JVC	HR2200/3320/3330/3660/1100/7700	**3.75**
AKAI	VS9700	**3.75**
HITACHI	VT5000	**3.75**
SHARP	VC6300/6500	**3.75**
SONY	TC6 GEN	**3.75**

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P.V. TUBES
FOR ALL YOUR COMPONENTS

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POST & PACKING 87p + VAT UP TO 1 KILO

FULL RANGE OF VIDEO LAMPS UNDER SPECIFIC SPARES IN CATALOGUE
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SKC

E60	2.00
E120	2.30
→ **E180**	**2.45** ←
E240	3.45
→ **L750**	**2.70** ←

SCOTCH

E30	2.90
E60	3.05
E120	2.89
→ **E180**	**3.50** ←
→ **L750**	**3.65** ←
VCC360	6.59
VCC480	7.50

VIDEO BELT KITS

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S4	1010/2010 EXTERNAL SIREN	(116db)	**5.96**
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Pb = Push Button
S = Slide)

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7030 (†) 0.1% version of 6010
5010EC (†) 34 range incl. CAP Hfe temp etc 0.25% (R)
M3530 (*) 28 range incl. 5 range CAP plus Hfe 10A AC/DC 0.5 (R)
M3800 (°) 30 range plus Hfe 20A AC/DC 20 meg 0.5% (R)
M3650 (°) 30 range incl. Hfe CAP freq. count. 20A AC/DC 0.3% (R)
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6511 (*°) Wallet auto range
DM205 (*°) 14 range 10A DC Hfe test display hold 0.5% (R)

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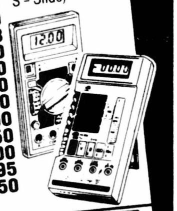
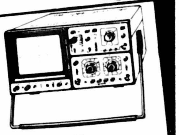


SCOPES (★with probes)



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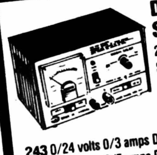

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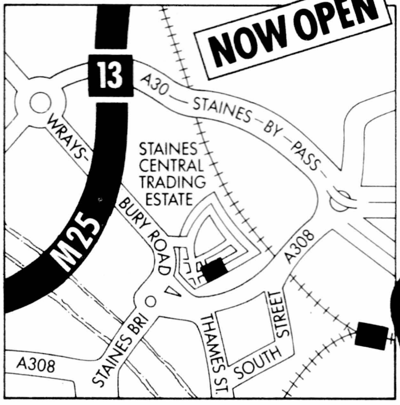
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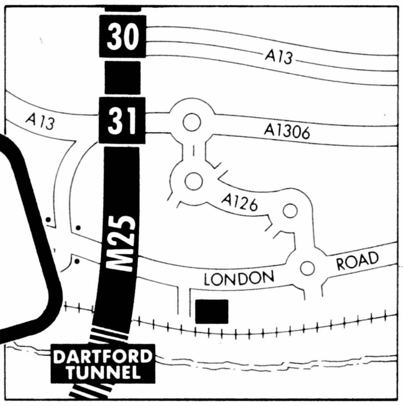
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AC187K	28p
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AC188K	28p
ACY18	48p
ACY19	48p
AD142	100p
AD149	60p
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AD162	35p
AD164	200p
AF124	30p
AF125	30p
AF126	30p
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AM150	28p
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AM154	35p
AM156	35p
AM158	50p
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BA148	10p
BA154	6p
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BB101	13p
BB103	16p
BB105B	18p
BB205B	24p
BC107	8p
BC108	8p
BC109	8p
BC109C	10p
BC115	10p
BC118	11p
BC140	20p
BC141	20p
BC142	20p
BC143	20p
BC147	8p
BC148	8p
BC149	8p
BC157	8p
BC159	8p
BC182	7p
BC182L	7p
BC183	7p
BC183L	7p
BC184	7p
BC184L	7p
BC212	7p
BC212L	7p
BC213	7p
BC213L	7p
BC214	7p
BC214L	7p
BC237	7p
BC238	7p
BC300	20p
BC301	20p
BC302	20p
BC303	20p
BC327	7p
BC328	7p
BC337	7p
BC338	7p
BC446	8p
BC449	15p
BC489	20p
BC490	18p
BC516	22p
BC528	22p
BC537	25p
BC546	8p
BC547	8p
BC548	8p
BC549	8p
BC550	8p
BC556	8p
BC557	7p
BC558	8p
BC559	8p
BC560	8p
BC637	20p
BC638	20p
BCY32	200p
BCY33	200p
BCY34	200p
BCY42	20p
BCY56	16p
BCY70	16p
BCY71	16p
BCY72	16p
BD111	99p
BD112	95p
BD115	30p
BD124P	50p
BD124	110p
BD128	35p
BD131	25p
BD132	25p
BD133	50p
BD135	20p
BD136	20p
BD137	20p
BD138	20p
BD139	20p
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BD175	30p
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BD184	60p
BD187	30p
BD201	33p
BD202	38p
BD203	42p
BD204	42p
BD222	31p
BD225	31p
BD232	31p
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BD238	24p
BD244	50p
BD245	50p
BD278	50p
BD331	40p
BD332	40p

BD370	30p
BD371	30p
BD433	28p
BD434	30p
BD435	31p
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BD438	36p
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BD441	40p
BD442	40p
BD533	50p
BD534	38p
BD535	38p
BD536	38p
BD537	40p
BD538	40p
BD675	40p
BD676	40p
BD677	38p
BD678	40p
BD679	40p
BD680	40p
BD681	45p
BD682	45p
BDX32	100p
BDX65	80p
BDW23	55p
BDW24	55p
BDY20	100p
BDY92	100p
BF137	35p
BF154	25p
BF167	30p
BF173	40p
BF178	30p
BF180	16p
BF181	18p
BF183	20p
BF184	20p
BF185	20p
BF194	7p
BF195	7p
BF196	8p
BF197	10p
BF198	10p
BF199	8p
BF200	16p
BF240	16p
BF241	10p
BF254	15p
BF255	12p
BF256	18p
BF257	18p
BF258	18p
BF259	18p
BF262	25p
BF263	25p
BF270	18p
BF273	15p
BF311	21p
BF324	25p
BF336	20p
BF337	20p
BF338	20p
BF355	28p
BF362	30p
BF367	13p
BF371	17p
BF391	18p
BF392	18p
BF414	18p
BF420	16p
BF421	18p
BF422	21p
BF423	15p
BF440	16p
BF451	17p
BF455	14p
BF458	19p
BF459	19p
BF461	60p
BF462	62p
BF469	30p
BF470	28p
BF471	28p
BF472	28p
BF479	30p
BF493	18p
BF494	16p
BF506	25p
BF595	16p
BF596	16p
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BF615	30p
BF758	41p
BF869	22p
BF870	22p
BF871	22p
BF872	23p
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BF963	40p
BF964	38p
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BFX89	60p
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BU208D	100p
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BU409	95p
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BU508A	120p
BU526	80p
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MJ10012	300p
MJ15001	325p
MJ15002	300p
MJ15003	325p
MJ15004	370p
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MJ2955	55p
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MR510	35p
MR856	36p
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MV1622	80p
MV209	48p
MV2209	48p
OC28	150p
OC29	80p
OC35	100p
OC36	120p
OC45	50p
OC71	30p
OC72	50p
OC200	180p
OT121	90p
R2008B	100p
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S2800M	72p
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TAG4442	76p
TAG4443	76p
TAG4444	76p
TIP29	15p
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TIP29C	25p
TIP30	25p
TIP30C	30p
TIP31A	24p
TIP31C	30p
TIP32	24p
TIP32A	24p
TIP32C	28p
TIP33	50p
TIP34	50p
TIP41A	22p
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TIP42A	22p
TIP42C	25p
TIP47	40p
TIP48	40p
TIP50	60p
TIP51	120p
TIP52	120p
TIP53	120p

TIP54	140p
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TIP106	65p
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TIP112	40p
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TIP126	56p
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TIP142	90p
TIP145	65p
TIP146	90p
TIP147	100p
TIP2955	42p
TIP3054	45p
TIP3055	42p
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TIS44	40p
TIS61	15p
TIS88A	45p
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TIS93	20p
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ZTX109	12p
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ZTX301	16p
ZTX302	16p
ZTX303	24p
ZTX304	17p
ZTX320	29p
ZTX326	29p
ZTX500	13p
ZTX501	13p
ZTX502	18p
ZTX503	18p
ZTX504	25p
ZTX550	24p
2N.696	26p
2N.697	22p
2N.698	40p
2N.699	45p
2N.706	22p
2N.708	22p
2N.914	28p
2N.918	36p
2N.930	18p
2N.1131	28p
2N.1132	28p
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2N.1893	30p
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2N.2160	300p
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2N.2219	24p
2N.2221	23p
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2N.2369	15p
2N.2484	20p
2N.2646	40p
2N.2904	20p
2N.2905	20p
2N.2906	18p
2N.2907	18p
2N.2926	8p
2N.3019	28p
2N.3053	18p
2N.3054	40p
2N.3055	38p
2N.3055H	50p
2N.3440	58p
2N.3442	85p
2N.3525	150p
2N.3583	90p
2N.3585	120p
2N.3702	9p
2N.3703	9p
2N.3704	9p
2N.3705	9p
2N.3706	9p
2N.3707	9p
2N.3708	9p
2N.3710	12p
2N.3711	12p
2N.3771	85p
2N.3772	90p
2N.3773	110p
2N.3799	18p
2N.3819	29p
2N.3866	68p
2N.3903	11p
2N.3904	11p
2N.3905	11p
2N.3906	11p
2N.4031	25p
2N.4036	25p
2N.4037	25p
2N.4058	13p
2N.4058	13p
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2N.4444	76p
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BY179	35p
BY182	32p
BY184	32p
BY187	32p
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BY207	11p
BY208	18p
BY210	22p
BY223	72p
BY225	120p
BY226	18p
BY227	19p
BY228	32p
BY296	20p
BY298	26p
BY299	28p
BY476	90p
BYX10	15p
BYX55/350	30p
BYX55/600	30p
BYX55/800	32p
BYX70/300	29p
BYX70/500	32p
BYX70/800	36p
BYX71/600	80p
OA47	6p
OA90	6p
OA91	8p
OA200	7p
OA202	7p
IN.914	2p
IN.4001	4p
IN.4002	4p
IN.4003	4p
IN.4004	4p
IN.4005	4p
IN.4006	4p
IN.4007	5p
IN.4148	2p
IN.5400	9p
IN.5401	10p
IN.5402	10p
IN.5403	11p
IN.5404	11p
IN.5405	12p
IN.5406	13p
IN.5407	13p
IN.5408	13p

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7815	35p
7818	35p
7824	35p
7905	35p
7912	40p
7915	40p
7918	40p
7924	40p
78L05	28p
78L12	28p
78L15	28p
78L18	28p
78L24	28p
79L05	40p
79L12	45p
79L15	48p
7818KC	100p
7824KC	100p
LM309K	100p
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LM317T	180p
LM323K	420p
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78HGKC	570p
78HO5KC	800p
78H12KC	700p
78GU1C	190p
79GU1C	215p
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DF96	50p
DL92	60p
DY86	50p
DY87	60p
DY802	55p
EABC80	60p
E891	44p
EBF80	45p
EBF89	50p
ECC82	55p
ECC83	65p
ECC84	50p
ECC85	50p
ECH81	65p
ECH84	65p
ECL80	57p
ECL82	59p
ECL84	57p
ECL85	57p
ECL86	70p
EF80	50p
EF85	50p
EF89	70p
EF183	60p
EF184	65p
EL34	210p
EL36	60p
EL84	50p
EL95	60p
EL500	80p
EL504	100p
EY86	31p
EY87	31p
EY88	42p
EZ35	45p
EZ80	50p
EZ81	55p
GZ34	180p
PC97	100p
PCC85	42p
PCF80	65p

PCF200	135p
PCF801	110p
PCF802	60p
PCF806	115p
PCH200	100p
PCL81	62p
PCL82	63p
PCL84	50p
PCL85	65p
PCL86	65p
PCL805	65p
PFL200	85p
PL36	80p
PL82	45p
PL83	32p
PL84	50p
PL95	140p
PL500	110p
PL504	95p
PL508	170p
PL519	450p
PY81	70p
PY88	57p
PY500A	160p

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AN-124	230p
AN-127	250p
AN-136	250p
AN-203	210p
AN-210	165p
AN-214Q	170p
AN-228	280p
AN-234	450p
AN-235	450p
AN-236	235p
AN-238	400p
AN-239Q	400p
AN-240P	150p
AN-241	135p
AN-245	290p
AN-247	230p
AN-252	150p
AN-259	250p
AN-262	140p
AN-270	200p
AN-271	230p
AN-272	480p
AN-274	250p
AN-294	380p
AN-295	340p
AN-301	330p
AN-303	250p
AN-304	360p
AN-305	320p
AN-306	800p
AN-313	270p
AN-315	210p
AN-316	350p
AN-318	460p
AN-331	295p
AN-360	100p
AN-362	140p
AN-366	150p
AN-610	160p
AN-612	160p
AN-3320K	900p
AN-5151	600p
AN-5430	280p
AN-5612	400p
AN-5620	330p
AN-5712	350p
AN-5722	140p
AN-5730	160p
AN-5732	160p
AN-5753	170p
AN-6100	425p
AN-6120	400p
AN-6135	150p
AN-6300	600p
AN-6320	300p
AN-6330	380p
AN-6340	830p
AN-6341	350p
AN-6344	440p
AN-6350	610p
AN-6359	810p
AN-6360	400p
AN-6362	480p
AN-6371	510p
AN-6387	560p
AN-6430	390p
AN-6431	400p
AN-6677	550p
AN-6811	130p
AN-6876	270p
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AN-7410	250p
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AN-7154	180p
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BA-314	100p
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BA-514	160p
BA-516	150p
BA-521	160p
BA-524	240p
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BA-534	290p
BA-535	600p
BA-536	210p
BA-612	160p
BA-658	380p
BA-684	400p
BA-685	400p
BA-1310	160p
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BA-1330	160p
BA-1360	160p
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BA-5402	250p
BA-5406	280p
BA-6104	250p

BA-6135	250p
BA-6208	250p
BA-6304	190p
CA-3011	110p
CA-3012	150p
CA-3014	250p
CA-3018	75p
CA-3019	75p
CA-3020	190p
CA-3023	190p
CA-3028A	95p
CA-3035	230p
CA-3036	240p
CA-3043	240p
CA-3045	360p
CA-3046	60p
CA-3048	190p
CA-3052	190p
CA-3054	95p
CA-3059	300p
CA-3060	280p
CA-3065	210p
CA-3080E	60p
CA-3085	135p
CA-3086	55p
CA-3088E	200p
CA-3089Q	250p
CA-3130E	80p
CA-3130S	100p
CA-3134E	38p
CA-3160	85p
CA-3161E	140p
CA-3162E	450p
CA-3189E	230p
CA-3193E	230p
CA-3240E	90p
CA-3260E	170p
CA-3290E	150p
CX-108	750p
CX-130	450p
CX-136	610p
CX-139A	1150p
CX-143A	580p
ER-1400	200p
HA-1125	150p
HA-1137W	160p
HA-1144	380p
HA-1156	110p
HA-1197	150p
HA-1199	160p
HA-1306W	170p
HA-1319	240p
HA-1338	300p
HA-1339A	170p
HA-1342	170p
HA-1366WR	160p
HA-1367	300p
HA-1368	160p
HA-1371	300p
HA-1372	300p
HA-1374	230p
HA-1377	210p
HA-1388	320p
HA-1389	210p
HA-1392	230p
HA-1394	280p
HA-1397	250p
HA-1398	240p
HA-1452	120p
HA-1457	120p
HA-11221	210p
HA-11223	340p
HA-11225	170p
HA-11226	410p
HA-11235	210p
HA-11701	310p
HA-11703	390p
HA-11705	620p
HA-11710	340p
HA-11715	560p
HA-11724	800p
HA-13001	260p
HA-13008	800p
ICL-7016	650p
ICL-7017	950p
ICL-7611	90p
ICL-7660	240p
ICM-7555	60p
ICM-7556	130p
LA-1111	180p
LA-1150	150p
LA-1201	80p
LA-1210	140p
LA-1222	80p
LA-1230	130p
LA-1231	210p
LA-1352	120p
LA-1364	200p
LA-1365	120p
LA-1368	220p
LA-1369	260p
LA-1385	170p
LA-1460	220p
LA-2000	150p
LA-2100	260p
LA-2101	270p
LA-2200	190p
LA-3100	125p
LA-3101	160p
LA-3120	125p
LA-3155	100p
LA-3160	120p
LA-3201	80p
LA-3210	65p
LA-3300	140p
LA-3301	110p
LA-3350	110p
LA-3361	100p
LA-3375	300p
LA-4030	180p
LA-4031	140p
LA-4032	140p
LA-4050	130p
LA-4100	100p
LA-4101	90p
LA-4102	120p
LA-4110	160p
LA-4112	160p
LA-4120	270p
LA-4125	200p
LA-4126	240p
LA-4135	250p
LA-4137	180p
LA-4140	70p
LA-4160	220p
LA-4180	300p
LA-4182	190p
LA-4190	300p
LA-4192	180p
LA-4200	130p
LA-4201	120p
LA-4210	150p
LA-4220	120p
LA-4230	175p
LA-4250	260p
LA-4261	300p
LA-4400	190p
LA-4420	140p
LA-4422	130p
LA-4430	130p
LA-4440	230p
LA-4445	260p
LA-4450	150p
LA-4460	170p
LA-4461	180p
LA-4500	230p

LA-4505	260p
LA-4507	360p
LA-4508	260p
LA-4510	160p
LA-4520	230p
LA-5112	120p
LA-5700	300p
LA-7520	500p
LA-7800	180p
LA-7801	280p
LA-7802	300p
LA-7803	400p
LA-7805	400p
LA-7806	260p
LA-7820	250p
LA-7910	150p
LAP-512	310p
LAG-552	200p
LAG-552	200p
LAG-600	200p
LAG-634D	30p
LAM-508	200p
LC-7120	280p
LC-7130	280p
LC-7131	260p
LC-7132	400p
LC-7137	450p
LF-347	110p
LF-351	45p
LF-353	48p
LF-355	60p
LF-356	60p
LF-357	70p
LF-398	300p
LM-301	26p
LM-307	42p
LM-308CN	70p
LM-310	220p
LM-311	35p
LM-318	120p
LM-319	165p
LM-324	35p
LM-325	45p
LM-334Z	115p
LM-335Z	120p
LM-336	140p
LM-337	250p
LM-339	37p
LM-348	55p
LM-358	45p
LM-377	220p
LM-380	100p
LM-381	150p
LM-382	130p
LM-383	300p
LM-384	130p
LM-386	85p
LM-387	100p
LM-389	150p
LM-391	160p
LM-392	100p
LM-393	55p
LM-394CH	370p
LM-558	160p
LM-709DIL	30p
LM-710	45p
LM-711	85p
LM-723	40p
LM-725CN	380p
LM-733	60p
LM-741DIL	18p
LM-741MET	45p
LM-747	58p
LM-748	35p
LM-1458	33p
LM-1889	400p
LM-3900	40p
LM-3909	80p
LM-3911	160p
LM-3914	250p
LM-3915	255p
LM-3916	290p
LM-8560	300p
LM-016H	3200p
M-5155	150p
M-50120	600p
M-51102	290p
M-51316B	540p
M-51513L	160p
M-51514	160p
M-51515BL	220p
M-51516	260p
M-51517L	260p
M-51518	200p
M-54836	600p
MB-3705	150p
MB-3712	140p
MB-3722	310p
MB-3730	240p
MB-3731	300p
MB-3756	230p
MB-3759	200p
MB-8719	360p
MC-1310P	130p
MC-1327	70p
MC-1413	65p
MC-1455	45p
MC-1458	33p
MC-1469	290p
MC-1488	65p
MC-1489	65p
MC-1494	670p
MC-1495	285p
MC-1496	65p
MC-1569	210p
MC-3302	70p
MC-3401	45p
MC-3403	60p
MC-3423	75p
MF-10	295p
ML-920	480p
ML-922	380p
NE-531	115p
NE-544	170p
NE-555	20p
NE-556	40p
NE-564	380p
NE-565	110p
NE-566	130p
NE-567	115p
NE-570	360p
NE-571	290p
NE-592	85p
NE-5532P	140p
NE-5533P	150p
NE-5534P	110p
SAS-560	110p
SAS-570	110p
STK-011	370p
STK-013	700p
STK-014	700p
STK-015	490p
STK-016	800p
STK-020	540p
STK-022	700p
STK-025	700p
STK-041	700p
STK-043	980p
STK-050	1450p
STK-077	600p
STK-078	620p
STK-080	710p
STK-082	720p
STK-086	910p
STK-430	500p
STK-433	490p

STK-435	510p
STK-436	490p
STK-437	600p
STK-439	550p
STK-441	740p
STK-443	740p
STK-457	580p
STK-459	610p
STK-460	720p
STK-461	720p
STK-463	780p
STK-465	800p
STK-501	580p
STK-563	480p
STK-0025	420p
STK-0029	430p
STK-0030	400p
STK-0039	410p
STK-0040	560p
STK-0049	570p
STK-0050	570p
STK-0059	620p
STK-0060	900p
STK-0070	1100p
STK-0080	690p
STK-1039	550p
STK-1040	700p
STK-1049	800p
STK-1070	1200p
STK-2025	800p
STK-2028	650p
STK-2029	500p
STK-2129	610p
STK-2139	800p
STK-2230	580p
STK-3041	600p
STK-3042	580p
STK-3062	600p
STK-3082	700p
STK-4026	800p
STK-4060	580p
STK-4211	800p
STK-4141	700p
STK-4332	500p
STK-4352	700p
STK-5315	650p
STK-7308	800p
STK-8250	700p
STK-4833	1200p
STR-440	520p
STR-441	480p
STR-451	500p
STR-6020	600p
T2800D	52p
TA-7054	190p
TA-7063	70p
TA-7066	120p
TA-7072	300p
TA-7073	200p
TA-7089	300p
TA-7108	130p
TA-7109	220p
TA-7119	150p
TA-7120	55p
TA-7130	80p
TA-7137	83p
TA-7140	130p
TA-7142	220p
TA-7145	220p
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TA-7162	300p
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TA-7212	300p
TA-7213	200p
TA-7214	260p
TA-7215	215p
TA-7217	145p
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TA-7222	120p
TA-7223	210p
TA-7224	270p
TA-7225	300p
TA-7226	290p
TA-7227	190p
TA-7229	300p
TA-7230	170p
TA-7232	250p
TA-7233	250p
TA-7237	400p
TA-7238	400p
TA-7240	260p
TA-7241	260p
TA-7245	450p
TA-7247	800p
TA-7269	850p
TA-7270	250p
TA-7271	400p
TA-7299	400p
TA-7310	100p
TA-7312	120p
TA-7313	110p
TA-7314	210p
TA-7315	200p
TA-7320	300p
TA-7324	200p
TA-7325	90p
TA-7328	200p
TA-7335	200p
TA-7357	400p
TA-7358	200p
TA-7401	400p
TA-7607	270p
TA-7608	360p
TA-7609	270p
TA-7611	280p
TA-7614	230p
TA-7621	520p
TA-7628	240p
TA-7640	150p
TA-7641	170p
TA-7658	130p
TA-7668	160p
TA-7688	250p
TAA-550	20p
TBA-120S	50p
TBA-395	60p
TBA-396	70p
TBA-520	120p
TBA-530	120p
TBA-540	120p
TBA-560	120p
TBA-750	120p
TBA-800	40p
TBA-810AS	60p
TBA-820	65p
TBA-920	120p
TBA-950	120p
TBA-990	120p
TC-9109	500p
TCEP-100	200p
TCA-830	90p
TCA-940	100p
TDA-1170	100p
TDA-1412	100p
TDA-2002	80p
TDA-2003	150p

TDA-2004	170p
TDA-2005	170p
TDA-2006	150p
TDA-2009	200p
TDA-2010	100p
TDA-2020	140p
TDA-2030	140p
TDA-2532	120p
TDA-2540	100p
TDA-2560	120p
TDA-2575A	100p
TDA-2600	580p
TDA-2690	100p
TDA-4600	260p
TEA1002	650p
TLO61	40p
TLO64	80p
TLO71	38p
TLO72	55p
TLO74	92p
TLO81	40p
TLO82	46p
TLO83	67p
TLO84	80p
UCN5801A	560p
ULN-2002	70p
ULN-2003	69p
ULN-2004	69p
ULN-2068	270p
ULN-2802	170p
ULN-2803	130p
ULN-2804	170p
UPC16C	160p
UPC20C	220p
UPC30C	190p
UPC358	150p
UPC554	130p
UPC555	60p
UPC556H	80p
UPC558	200p
UPC566	60p
UPC571	220p
UPC572	200p
UPC574	60p
UPC575C2	90p
UPC576	200p
UPC577	64p
UPC578	400p
UPC580	300p
UPC592	95p
UPC595	190p
UPC596	190p
UPC1001	220p
UPC1018	170p
UPC1020	200p
UPC1021	200p
UPC1023	60p
UPC1025	230p
UPC1026	95p
UPC1028	90p
UPC1031H2	180p
UPC1032	60p
UPC1155	200p
UPC1156	250p
UPC1158H2	70p
UPC1167C2	170p
UPC1168	105p
UPC1181	110p
UPC1182	110p
UPC1183	200p
UPC1185H2	250p
UPC1186	80p
UPC1187	150p
UPC1191	100p
UPC1197	140p
UPC1216	120p
UPC1222	130p
UPC1230	210p
UPC1238	120p
UPC1263	230p
UPC1277	240p
UPC1278	240p
UPC1350	115p
UPC1353	160p
UPC1363	190p
UPC1365	320p
UPC1373	85p
UPC1378	210p
UPC1380	450p
UPC1382	110p
UPC1383	250p
UPC1384	260p
UPC1394	170p
UPC1397	450p
UPC1470	200p
ZN-423	100p
ZN-424	100p
ZN-425	320p
ZN-426	260p
ZN-427	560p
ZN-428	425p
ZN-429	215p
ZN-435	340p
ZN-448	510p
ZN-459	190p
ZN-1034	170p
ZN-1040	640p
ZNA-134H	2150p
ZNA-234E	920p

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2SA-473	50p
2SA-562	57p
2SA-634	50p
2SA-636	50p
2SA-684	60p
2SA-715	90p
2SA-733	30p
2SA-899	60p
2SA-940	80p
2SA-953	33p
2SA-1012	130p
2SA-1015	30p
2SA-1102	200p
2SA-1103	200p
2SA-1104	220p
2SA-1105	250p
2SA-1106	250p
2SB-022	80p
2SB-324	55p
2SB-370	45p
2SB-616	190p
2SB-705	200p
2SB-754	80p
2SB-755	310p
2SB-795	60p
2SB-861	160p
2SB-951	190p

2SC-461	30p
2SC-495	60p
2SC-536	30p
2SC-733	30p
2SC-828	25p
2SC-945	40p
2SC-1060	99p
2SC-1061	200p
2SC-1096	78p
2SC-1114	415p
2SC-1115	500p
2SC-1116	410p
2SC-1161	110p
2SC-1172	150p
2SC-1173	80p
2SC-1213	70p
2SC-1214	50p
2SC-1279	30p
2SC-1306	90p
2SC-1308K	350p
2SC-1317	32p
2SC-1342	130p
2SC-1383	75p
2SC-1384	70p
2SC-1398	80p
2SC-1505	80p
2SC-1507	140p
2SC-1509	110p
2SC-1675	100p
2SC-1678	120p
2SC-1758	30p
2SC-1815	30p
2SC-1826	60p
2SC-1865	120p
2SC-1875	260p
2SC-1881	210p
2SC-1906	75p
2SC-1909	250p
2SC-1942	290p
2SC-1945	350p
2SC-1946	1500p
2SC-1947	450p
2SC-1957	70p
2SC-1969	160p
2SC-1972	600p
2SC-2001	60p
2SC-2026	60p
2SC-2028	75p
2SC-2029	120p
2SC-2075	80p
2SC-2078	95p
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2SC-2166	90p
2SC-2238	70p
2SC-2240	45p
2SC-2314	70p
2SC-2335	120p
2SC-2458	40p
2SC-2547	65p
2SC-2570	60p
2SC-2577	150p
2SC-2578	220p
2SC-2579	240p
2SC-2580	240p
2SC-2581	290p
2SC-2611	65p
2SC-3150	200p
2SC-3293	85p
2SC-3156	400p
2SC-1413	265p
2SD-024	60p
2SD-313	70p
2SD-325	60p
2SD-348	460p
2SD-371	240p
2SD-401	130p
2SD-438	100p
2SD-600	120p
2SD-613	70p
2SD-718	100p
2SD-1277	190p
2SD-1398	250p
2SD-1453	180p
2SD-1609	110p

BRIDGE RECTIFIERS

1A/50V	16p
1A/100V	18p
1A/200V	19p
1A/400V	21p
1A/600V	23p
1A/800V	28p
2A/100V	33p
2A/200V	33p
2A/400V	37p
2A/600V	43p
2A/800V	43p
3A/200V	43p
3A/400V	43p
3A/600V	44p
6A/200V	80p
6A/400V	72p
25A/100V	150p
25A/200V	165p
25A/400V	185p
25A/600V	200p
25A/800V	240p
35A/100V	185p
35A/200V	200p
35A/400V	220p
35A/600V	230p
35A/800V	260p
1.5A/100V	40p
1.5A/800V	40p

TRIACS PLASTIC

4A/400V	60p
6A/400V	69p
8A/400V	68p
12A/400V	85p
16A/400V	105p
20A/400V	190p
25A/400V	205p
8A/400V	52p

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0.8A/60V	20p
0.8A/100V	28p
0.8A/200V	29p
4A/400V	28p
8A/400V	59p
8A/400V	70p
8A/400V	79p
12A/400V	75p
12A/600V	90p
2N.4444	76p
BT106	120p
BT116	80p
BT119	100p
BT120	100p

TIC44	22p
TIC45	27p
TIC47	32p

OPTO ELECTRONICS

2N 5777	40p
OCP71	100p
ORP12	85p
ORP60	100p
ORP61	100p

DISPLAYS

MAN.72	115p
MAN.74	115p
MAN.4640	180p
MAN.8910	230p
DL.747	160p

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2114	200p
2532	330p
2716	200p
2732	280p
2732A	300p
2764	240p
27C64	550p
27128	350p
27256-25	400p
41256-15	300p
256DRAM	300p
4116	75p
4164	110p
6116	160p
6264-15	250p
6502	300p
6502A	400p
65CO2	930p
6503	570p
6520	170p
6522	330p
6530	1050p
6532	460p
6545	880p
6551	530p
6800	210p
6802	220p
6803	800p
6808	500p
6809	600p
6810	150p
6818	380p
6820	140p
6821	140p
6840	310p
6845	620p
6850	110p
8080A	400p
8085A	300p
8155	360p
8156	360p
81LS95	120p
81LS96	130p
81LS97	130p
81LS98	130p
8224	270p
8226	270p
8228	270p
8243	250p
8250	850p
8087	£110.00
8251	300p
8253	320p
8255	310p
8256	1200p
8257	350p
8259	360p
8271	3400p
8272	1200p
8279	450p
8282	300p
8283	400p
8284	440p
8287	360p
8288	650p
8748	1100p
8755	1400Pp
AY3-1015	290p
AY5-3600	570p
SPO256AL2	500p
Z80ACPU	180p
Z80BCPU	500p
Z80ADMA	650p
Z80APIO	230p
Z80BPIO	480p
Z80ACTC	250p
Z80BCTC	480p
Z80ASIO	660p
Z80ASIO-1	700p
Z80ASIO-2	700p
Z80ADART	680p
74S188	175p
74S189	210p
74S201	240p
74S287	190p
74S288	160p
74S289	180p
74S387	200p
75107	80p
75108	80p
75109	110p
75110	80p
75112	140p
75113	105p
75114	130p
75115	130p
75121	125p
75122	125p
75150	110p
75154	110p
75158	140p
75159	200p
75160	400p
75161	400p
75162	700p
75172	720p
75182	100p
75183	100p
75188	60p
75189	60p
75195	185p
75322	130p
75324	340p
75325	155p
75365	145p
75450	45p
75451	42p
75452	42p
75453	65p

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SL-C7/SL-JL	(6)	£1.95
SANYO		
VTC-5300	(5)	£1.90
VTC-5500	(3)	£1.10
VTC-9300	(4)	£2.40
HITACHI		
VT-5000	(7)	£1.95
VT-8000	(3)	£1.10
VT-11	(5)	£2.20
TOSHIBA		
V-5475	(6)	£1.90
V-7540	(5)	£1.90
V-8600	(6)	£1.50
SHARP		
VC-7300	(5)	£1.60

CASSETTE MOTOR

6V	£2.90
9V CW	£2.90
12V CCW	£2.90
12V CW	£2.90
13.2V CW	£2.90
13.2V CCW	£2.90

CASSETTE TAPE HEADS

MONO HEAD	£1.30
STEREO HEAD	£2.20
MONO MINI HEAD	£2.50
AUTO REVERSE HEAD	£2.60

VIDEO MOTORS

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REEL MOTOR (RM11) P/N 4-529V-10800	£8.00
CAPSTAN MOTOR 4-527V-51000	£24.00
SONY	
CAPSTAN MOTOR BHF-1100D	£23.00
SHARP	
REEL MOTOR RMOTV 1007 GEZZ	£17.50
REEL MOTOR RMOTV 1008 GEZZ	£17.50
LOADING MOTOR RMOTM 1017	£10.00
JVC	
CAPSTAN MOTOR PU-55371V	£22.00
CAPSTAN MOTOR PU-45979	£22.50
DRUM MOTOR PU-46414	£22.50
TOSHIBA	
CAPSTAN MOTOR 70125101	£28.00

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REEL PULLEY 143-0-662T-01201	£5.20
SONY	
REW. PULLEY A-6706-348-B	£4.00
REW. PULLEY A-6706-391-A/B	£3.00
SHARP	
IDLER SHARP NIDL0005 GEZZ	£2.25
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IDLER ASSEMBLY 6886971	£3.00
IDLER ASSEMBLY V-6861482	£3.85
JVC	
IDLER ASSEMBLY PU-47752	£5.00

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NATIONAL	
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NV-7000	£4.75
SANYO	
VTC-9300	£4.75
VTC-5500	£4.75
SONY	
SL-T7	£4.75
SL-C7	£4.75
JVC	
HR-3300	£5.00
HR-3330	£5.00
HR-3360/3660	£5.00
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VS-9700EG	£3.60
HITACHI	
VT-5000	£4.75
SHARP	
VC-6300/6500	£5.00

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made in UK

Size 41·5 × 25 × 17cm approx. Impedance 6 ohm nominal. Finished in simulated black teak with matching grille.

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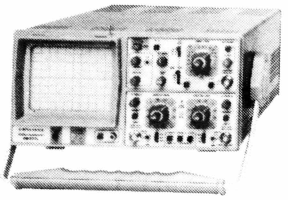

SPECIFICATION
- Bandwidth DC-20MHz
- Sens. Ch1, Ch2. 2mV/cm
- Time Base 0·2s/cm – 20ns/cm
- Trigger DC-40MHz AC, DC, HF, LF, (TV Frame) Active TV Sinc. Sep.
- Invert both channels
- Variable hold-off 10:1
- Calibrator
- Plus many more features

Price £314.00 + £47.10 V.A.T.

Including two probes

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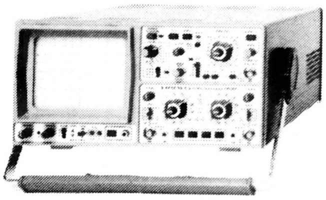
- Sens. Ch1, Ch2. 1mV/cm
- Delay Line
- Time Base 1·25s/cm – 10ns/cm
- Delayed Sweep 100ns – 0·1s
- Trigger DC-50MHz AC, DC, HF, LF, (TV Frame)
- Variable hold-off 10:1
- Overscan LED indicators
- Calibrator
- Plus many more features



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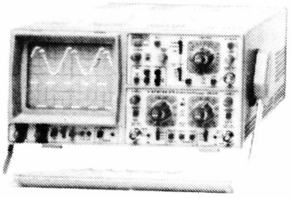


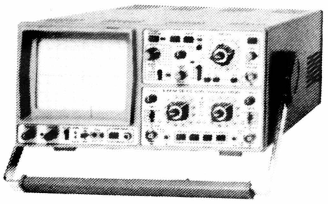
SPECIFICATION
- Digital Storage
- Analogue Real Time (Same as 203-6)
- Bandwidth DC-20MHz
- Sens. Ch1, Ch2. 2mV/cm
- Trigger DC-40MHz AC, DC, HP, LF, (TV Frame), Active TV Sinc. Sep.
- 100KHz Sample Rate
- 2 x 1K Storage
- Storage Range. 1ms-5s/cm
- Variable hold-off 10:1
- Calibrator
- Plus many more features

Price £498.00 + £74.70 V.A.T.
Including two probes

HM605 60MHz Multi-function

FREE Securicor Delivery

SPECIFICATION
- Bandwidth DC-60MHz
- Sens. Ch1, Ch2. 1mV/cm
- Delay Line
- Delayed Sweep 100ns – 0·1s
- Trigger DC-80MHz AC, DC, HF, LF, (TV Frame)
- Variable hold-off 10:1
- Switchable Calibrator
- Overscan LED indicators
- Plus many more features



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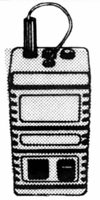

Tests and rejuvenates blue, green & red guns separately. Fitted with delta and P.I.L. sockets. Compact size 120×65×60 mm. Supply 240V AC

Price £32.00 + £4.80 V.A.T.

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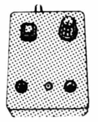
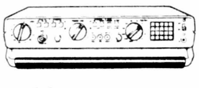
Revolutionary L.O.P.T. tester. Operates in dynamic mode which actually tests the L.O.P.T. under high voltage conditions without de-soldering or removal. Size 75×100×40 mm. Supply 240V AC



Price £25.99 + £3.90 V.A.T.

THANDAR SC110A PORTABLE OSCILLOSCOPE



- Only 2¼" thick
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- Bandwidth 10MHz
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- Size 255mm x 148mm x 50mm

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DIGITAL LCR METER

- LCD Display
- 18 Ranges
- Inductance 1μH – 2H
- Capacitance 1pf – 200μf
- Resistance 1 ohm – 20Mohm
- High acuracy

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- Electronic battery operated
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Model 467 Tri-dynamic three meter instrument Inc. 6 common adaptors	**£399.00 + £59.85 V.A.T.**
Without adaptors	**£349.00 + £52.35 V.A.T.**
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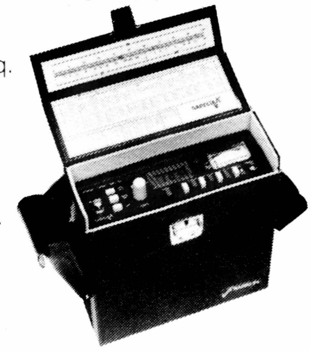
Technical leaflets available. GET INTO PROFIT NOW!

SADELTA FIELD STRENGTH METER TC-402

THE SADELTA FIELD STRENGTH METER TC-402 has been designed to measure the signal levels delivered by the antenna to a TV or FM receiver, in order to test the performance of the antenna and evaluate the best conditions during installation etc. To facilitate measurements, the tuning frequency readout is shown on a digital display.

FEATURES

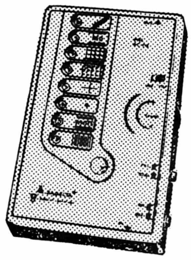


- ★ Covering FM and all TV bands (UHF/VHF) including CATV freq.
- ★ Digital tuning display (3 digits) for direct frequency readout.
- ★ Accurate 10 turn tuning potentiometer.
- ★ Built-in loudspeaker enables monitoring of sound in AM/FM.
- ★ Meter measurement in voltage and dB from 20μV (26dB/μV).
- ★ Continuity tester 0-500 ohms.
- ★ Fully portable (battery).
- ★ Sturdy carry case.

Price £249.00 + £37.35 V.A.T.

SADELTA COLOUR PATTERN GENERATORS

THE SADELTA RANGE OF HAND HELD COLOUR PATTERN GENERATORS is intended for use in production, installation and service of both colour and monochrome TV sets, video and computer monitors. In order to control and adjust the various parameters eight switchable patterns are provided. The technician has ready access to Laboratory, workshop and field use as the Generator has been designed using the latest micro-technology to achieve truly pocket size instruments. Internal re-chargeable Ni-Cd's. Supplied with 9V power supply charger. Size 131mm x 81mm x 23mm.



T.V. PATTERN GENERATOR PAL MC11B UK

- Band IV (21-34)
- Band III (5-12)
- PAL I.
- O/Put 10mV into 75ohms
- Sound output

Price £124.95 + £18.74 V.A.T.

PAL VIDEO COMPOSITE GENERATOR

- PAL B.G.I.
- O/Put 1V p.p. @ 75ohms
- Audio O/Put 10mV
- Switching 12V @ 4K7ohms

Price £124.95 + £18.74 V.A.T.

SECAM VIDEO COMPOSITE GENERATOR

- SECAM B.G.D.K.L.
- O/Put 1V p.p. @ 75ohms
- Audio O/Put 10mV
- Switching 12V @ 4K7ohms

Price £124.95 + £18.74 V.A.T.

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- O/Put sigs. Pos.RGB Neg. Composite
- O/Put TTL 5V P-P
- Blank Pulse etc. CCIR

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DIGITAL THERMOMETER

- Pocket Size
- −50°C to + 750°C
- 1°C Resolution
- 0.5" LCD
- Supplied with thermocouple

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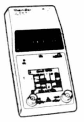
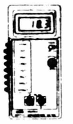
200MHz DIG. FREQ. METER



- Pocket Size
- 8 Dig. LED Display
- Freq. Range 20Hz to 200MHz
- Resolution 0.1Hz
- Sensitivity 10mV

Price £75.50 + £11.32 V.A.T.

DIGITAL CAPACITANCE METER



- ★ High Accuracy
- ★ 0·1pf-2,000μf
- ★ LCD display
- ★ 8 Ranges
- ★ Accuracy ±0·5%
- ★ Full scale ±1 digit

PRICE
£38.00
+ £5.70 VAT
Case Included

The **THANDAR TP1 LOGIC PROBE** and **TP2 LOGIC PULSER** are effective and economical tools for checking both TTL and CMOS circuits. TP1 can show 14 different circuit conditions and can detect pulses down to typically 10ns. TP2 can inject a signal directly into a circuit without damaging sensitive components. Together they can stimulate and monitor responses of components 'in circuit', greatly aiding fault finding.

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7 – 4in flex line switches with neons
8 – 2 80 watt brass cased elements
9 – 2 mains transformers with 6V 1A secondaries
10 – 2 mains transformers with 12V ½A secondaries
11 – 1 extension speaker cabinet for 6½″ speaker
12 – 5 octal bases for relays or valves
13 – 12 glass reed switches
14 – 4 OCP 70 photo transistors
16 – 4 tape heads, 2 record, 2 erase
17 – 1 ultrasonic transmitter and 1 ditto receiver
18 – 2 15000 mfd computer grade electrolytics
19 – 2 light dependent resistors
20 – 5 different micro switches
21 – 2 mains interference suppressors
22 – 2 25 watt crossover units 2 way
23 – 1 40 watt 3 way crossover unit
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30 – 2 Nicad battery chargers
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34 – 96 × 1 metre lengths colour-coded connecting wires
36 – 2 air spaced 2 gang tuning condensors
37 – 2 solid diaelectric 2 gang tuning condensors
38 – 10 compression trimmers
41 – 6 rocker switch 10 amp mains SPST
43 – 5 Rocker Switches 10 amp SPDT Centre Off
44 – 4 Rocker Switches 10 amp DPDT
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46 – 1 6 hour clock timeswitch
48 – 2 6V operated reed switch relays
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51 – 1 × 12V 2 CO very sensitive relay
52 – 1 12V 4 C relay
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60 – 5 ferrite rods 4″ × 5/16″ diameter aerials
61 – 4 ferrite slab aerials with L&M wave coils
62 – 4 200 ohm earpieces
63 – 1 Mullard Thyristor trigger module
64 – 10 assorted knobs ¼ spindles
65 – 5 different thermostats, mainly bi-metal
66 – Magnetic brake – stops rotation instantly
67 – low pressure 3 level switch
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70 – 2 25 watt pots 1000 ohm
71 – 4 wire wound pots – 18, 33, 50 and 100 ohm
73 – 4 3 watt wire wound pots 50 ohm
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78 – 5.5 amp stud rectifiers 400v
85 – 1 mains shaded pole motor ¾″ stack – ¼″ shaft
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88 – mains motor suitable for above blades
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91 – 2 mains motors with gear box 16 rpm
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94 – 5 B7G valve bases
95 – 4 skirted B9A valve bases
96 – 1 thermostat for fridge
98 – 1 motorised stud switch (s.h.)
101 – 1 2½ hours delay switch
103 – 1 6V mains power supply unit
104 – 1 4½V mains power supply unit
105 – 1 5 pin flex plug and panel socket
107 – 1 5″ speaker size radio cabinet with handle
109 – 10 ¼″ spindle type volume controls
110 – 10 slider type volume controls
112 – 1 heating pad 200 watts mains
114 – 1 1W amplifier Mullard 1172
115 – 1 wall mounting thermostat 24V
118 – 1 teak effect extension 5″ speaker cabinet
120 – 2 p.c.b. with 2 amp full wave and 17 other recs
122 – 10 mtrs twin screened flex white p.v.c. outer
132 – 2 plastic boxes with windows, ideal for interrupted beam switch etc
155 – 3 varicap push button tuners with knobs
188 – 1 plastic box sloping metal front, 16 × 95mm, average depth 45mm
241 – 1 car door speaker (very flat) 6½″ 15 ohm made for Radiomobile
243 – 2 speakers 6″ × 4″ 15 ohm 5 watt made for Radiomobile
266 – 2 mains transformers 9V ½A secondary split primary so ok also for 115V
267 – 1 mains transformer 15V 1A secondary p.c.b. mounting
330 – 2 6V 0.6V mains transformer. 3A p.c.b. mounting
350 – 40 double pole leaf switches
365 – 1 7uf 660V 50Hz metal cased condenser
453 – 2 2¼in. 60ohm loudspeakers
454 – 2 2¼in. 8ohm loudspeakers
463 – 1 mains operated relay with 2 sets c/o contacts
464 – 2 packets resin filler/sealer with cures
465 – 3 5A round 3 pin plugs will fit item 193
466 – 4 7 segment l.e.d. displays
470 – 4 pc boards for stripping, lots of valuable parts
480 – 1 3A double pole magnetic trip, saves repairing fuses
498 – 4 1000uf 25V axial electrolytic capacitors
504 – 1 Audax PM 8″ speaker 15 ohm 5 watt rating
515 – 100 4BA 1½″ cheesehead plated screws and 100 4BA nuts
541 – 1 pair stereo tape head as in cassette recorder/players
546 – 1 bridge rectifier 600V international rectifier ref 3SB 100
548 – 2 battery operated relays (3-6V) each with 5A c/o contacts 2 pairs
563 – 2 lithium 3V batteries (everlasting shelf file)

OVER 400 GIFTS YOU CAN CHOOSE FROM

There is a total of over 400 packs in our Baker's dozen range and you become entitled to a free gift with each dozen packs.

A classified list of these packs and our latest "News Letter" will be enclosed with your goods, and you will automatically receive our next news letter.

THIS MONTH'S SNIP

3½ floppy Disk Drive, made by the Chinon Company of Japan. Beautifully made and probably the most compact device of its kind as it weighs only 600g and measures only 104mm wide, 162mm deep and has a height of only 32mm, other features are high precision head positioning – single push loading and eject – direct drive brushless motor – 500K per disc – Shugart compatible interface – standard connections – interchangeable with most other 3½ and 5¼ drives. Brand new with copy of makers manual. Offered this month at **£28.50** post and VAT included.

CASE – adaptable for 3″ or 3½″ FDD, has room for power supply components price only **£4** includes circuit of PSU. Our Ref 4P8.

POWER SUPPLY FOR FDD – 5V and 12V voltage regulated outputs, complete kit of parts will fit into case 4P8 pice **£8** or with case **£11.**

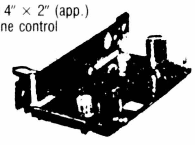
MULLARD UNILEX AMPLIFIERS

We are probably the only firm in the country with these now in stock. Although only four watts per channel, these give superb reproduction. We now offer the 4 Mullard modules – i.e. Mains power unit (EP9002) Pre amp module (EP9001) and two amplifier modules (EP9000) all for **£6.00** plus £2 postage. For prices of modules bought separately see **TWO POUNDERS.**

CAR STARTER/CHARGER KIT

Flat Battery! Don't worry you will start your car in a few minutes with this unit – 250 watt transformer 20 amp rectifiers, case and all parts with data case **£17.50** post £2.

MINI MONO AMP on p.c.b. size 4″ × 2″ (app.) Fitted volume control and a hole for a tone control should you require it. The amplifier has three transistors and we estimate the output to be 3W rms. More technical data will be included with the amp. Brand new, perfect condition, Offered at the very low price of **£1.15 each or £13 for 12.**



LIGHT BOX

This when completed measures approximately 15″ × 14″. The light source is the Philips fluorescent "W" tube. Above the light a sheet of fibreglass and through this should be sufficient light to enable you to follow the circuit on fibreglass PCBs. Price for the complete kit, that is the box, choke, starter, tube and switch and fibreglass is **£5** plus £2 post, order ref 5P69.

TANGENTIAL HEATERS

We again have very good stocks of these quiet running instant heat units. They require only a simple case, or could easily be fitted into the bottom of a kitchen unit or book case etc. At present we have stocks of 1.2kw, 2kw, 2.5kw, and 3kw. Prices are **£5** each for the first 3, and **£6.95** for the 3k. Add post £1.50 per heater if not collecting. CONTROL SWITCH enabling full heat, half heat or cold blow, with connection diagram, **50p** for 2kw, **75p** for 3kw.

FANS & BLOWERS

5″ **£5** + £1.25 post. 6″ **£6** + £1.50 post.
4″ x 4″ Muffin equipment cooling fan 115V **£2.00**
4″ x 4″ Muffin equipment cooling fan 230/240V **£5.00**
9″ Extractor or blower 115V supplied with 230 to 115V adaptor **£9.50** + £2.00 post.
All above are ex computers but guaranteed 12 months.
10″ x 3″ Tangential Blower. New. Very quiet – supplied with 230 to 115V adaptor on use two in series to give long blow **£2.00** + £1.50 post or **£4.00** + £2.00 post for two.

9″ MONITOR

Ideal to work with computer or video camera uses Philips black and white tube ref M24/306W. Which tube is implosion and X-Ray radiation protected. VDU is brand new and has a time base and EHT circuitry. Requires only a 16V dc supply to set it going. It's made up in a lacquered metal framework but has open sides so should be cased. The VDU comes complete with circuit diagram and has been line tested and has our six months guarantee. Offered at a lot less than some firms are asking for the tube alone, only **£16** plus £5 post.

LOW COST OSCILLOSCOPE – kit to convert our 9″ monitor into an oscilloscope with switched time bases to allow very high and very low frequency waveforms to be observed and measured. Signal amplitudes from as low as 10mV and as high as 1kV can easily be observed and measured. Ideal for servicing, also for investigating TV, radio and audio circuits.
Kit contains all the parts for the conversion and the power supply to operate from mains **£25** our ref 25P3.

TELEPHONE LEAD

3 mtrs long terminating one end with new BT, flat plug and the other end with 4 correctly coloured coded wires to fit to phone or appliance. Replaces the lead on old phone making it suitable for new BT socket. Price **£1** ref BD552 or 3 for **£2** ref 2P164.

COMPACT FLOPPY DISC DRIVE EME-101

The EME-101 drives a 3″ disc of the new standard which despite its small size provides a capacity of 500k per disc, which is equivalent to the 3½″ and 5¼″ discs. We supply the Operators Manual and other information showing how to use this with popular computers: BBC, Spectrum, Amstrad etc. All at a special snip price of **£27.50** including post and VAT. Data available separately **£2,** refundable if you purchase the drive.

POWERFUL IONISER

Generates approx. 10 times more IONS than the ETI and similar circuits. Will refresh your home, office, shop, workroom etc. Makes you feel better and work harder – a complete mains operated kit, case included **£11.50** + £3 P&P.

J & N BULL ELECTRICAL

Dept. T.V., 250 PORTLAND ROAD, HOVE, BRIGHTON, SUSSEX BN3 5QT.

MAIL ORDER TERMS: Cash, P.O. or cheque with order. Orders under £20 add £1 service charge. Monthly account orders accepted from schools and public companies. Access & B/card orders accepted. Brighton (0273) 734648 or 203500.

NEW ITEMS

Some of the many described in our current list which you will receive with your parcel.

SUPER WATER PUMP – Approx ⅓hp mains operated originally intended to operate a £300 shower unit at a controlled pressure – but of course suitable for many other water or liquid moving operations – where a good flow at a constant pressure is required – Price £25 each V.A.T. and Post Paid. Our Ref. 25P2.
VERY USEFUL MULTITESTERS – These have all usual ranges AC & DC volts – DC MA and OHMS etc but an unusual and very useful feature is a "low OHMS" range. Very useful for checking dry joints etc. They are ex G.P.O., and may have faults but we test and guarantee the movement to be O.K. Price £3 each. Ref. 3P30.
AGAIN AVAILABLE – 12″ mini fluorescent tubes – Price £1 each. Ref. BD314.
POWER PACK OR AMPLIFIER CASE – Size approx 10″ x 8¼″ x 4¾″ plated steel – with ample perforations fo cooling. Front panel has on/off switch and E.E.C. mains inlet plug with built in RF filter – undoubtedly a very fine case which would cost at least £50 from regular sources, our price is £5 each and £3 post. Ref. 5P111.
MINIATURE BCD THUMB WHEEL SWITCH – Matt black edge switch engraved white on black – gold plated, make before break contacts – size approx. 25mm high 8mm wide 20mm deep – made by the famous Cherry Company and designed for easy stacking – Price £1 each. Ref. DB601.
EDGE METER – miniature, whole size approx. 37mm x 13mm 100ua fsd – centre zero scaled 0 to −10 and 0 to +10. Price £1 each. Ref. DB602.
LARGE 2 SPEED MOTOR – 1hp at 2500rpm and ¼hp at 200rpm – continental make, intended originally to power an industrial machine – regular price over £60, our Price £15 plus £5 carriage. Ref. 15PS.
RUBBER FEET – Stick on – ideal for small instruments and cabinets – pack of 56 for £1. Ref. BD603.
CLEANING FLUID – Extra good quality – intended for video and tape heads – regular price £1.50 per spray can – our Price – 2 cans for £1. Ref. BD604.
DON'T FREEZE UP! – We have had the strongest winds for over 200 years and who knows may be in for coldest winter, so if you have not already protected your water pipes you should do so now – our heating wire wound around the pipes will do this and will cost only about 50p per week to run – 15 metres (minimum length to connect to 220/240v mains). Price £5. Our Ref. 5P109.
PIEZO ELECTRIC FAN an unusual fan, more like the one used by Madame Butterfly, than the conventional type, it does not rotate. The air movements is caused by two vibrating arms. It is American made, mains operated, very economical and causes no interference. So it is ideal for computer and instrument cooling. Price is only £1 each. Ref. BD605.
SPRING LOADED TEST PRODS – heavy duty, made by the famous Bulgin company. Very good quality. Price four for £1. Ref. BD599.
CURLY LEAD – four core, standard replacement for telephone handset, extends to nearly two metres. Price £1 each. Ref. BD599.
TELEPHONE BELLS – these will work off our standard mains through a transformer, but to sound exactly like a telephone, they then must be fed with 25hz 50v. So with these bells we give a circuit for a suitable power supply. Price 2 bells for £1. Ref. BD600.
ULTRA SENSITIVE POCKET MULTIMETER – 4k ohms per volt – 11 ranges – carry one of these and so be always ready to test ac/dc volts to 1000, DC milligrams and have an ohms range for circuit testing – will earn its cost in no time. Price only £7. Ref. 7P2.
BLOW YOUR ROOF OFF 140 watt speaker systems – new type you must not hide! They have golden cones and golden surrounds and look really "Bootiful" 12″ Woofer, Midrange and Tweeter and comes with a crossover at a special introductory price of £49, carriage paid. Two sets for £95 carriage paid. 140w Woofer only £35 carriage paid.
3½ & 5¼ FLOPPY DISC DRIVES now in stock all are new and made by famous Epson company. All are double sided drives with storage capacity of 1 meg byte. They have standard connections and are fully compatible with conventional systems. Both are small size and light weight. Price – either model is £57.50 plus £3 post. Price includes copy operating data.
APPLIANCE THERMOSTATS – spindle adjust type suitable for convector heaters or similar. Price 2 for £1. Ref. BD582.

COMPUTERS

Big consignment of computers expected in mid Jan, various makes and numbers, write or phone for details.

NOVEL NIGHT LIGHT – plugs into a 13A socket. Gives out a surprising amount of light, certainly enough to navigate along passages at night or to keep a nervous child happy. Very low consumption, probably not enough to move the meter. Price £1. Ref. BD563.
CASE WITH 13A PRONGS – to go into 13A socket, nice size and suitable for plenty of projects such as car battery trickle charger, speed controller, time switch, night light, noise suppressor, dimmers etc. Price – 2 for £1. Ref. BD565.
SPEAKER EXTENSION CABLE – twin 0.7mm conductors so you can have long runs with minimum sound loss and for telephone extensions or burglar alarms, bells, intercoms, etc. 250m coil only £3 plus £1 post. Ref. 3P28.
ALPHA-NUMERIC KEYBOARD – this keyboard has 73 keys with contactless capacitance switches giving long trouble free life and no contact bounce. The keys are arranged in two groups, the main area field is a QWERTY array and on the right is a 15 key number pad, board size is approx. 13″ x 4″ – brand new but offered at only a fraction of its cost namely £3, plus £1 post. Ref. 3P27.
TELEPHONE EXTENSIONS – it is now legal for you to undertake the wiring of telephone extensions. For this we can supply 4 core telephone cable, 100m coil £8.50. Extension BT sockets £2.95. Packet of 500 plastic headed staples £2. Dual adaptor for taking two appliances from one socket £3.95. Leads with BT plug for changing old phones 3 for £2.
MODULAR SWITCH - Panel mounting highest quality and ideal where extra special front panel appearances is required, can be illuminated if required d.p.d.t. and latching. Price – 2 for £1. Ref. BD607.
WIRE BARGAIN – 500 metres 0.7mm solid copper tinned and p.v.c. covered. Only £3 + £1 post. Ref. 3P31 – that's well under 1p per metre, and this wire is ideal for push on connections.
INTERRUPTED BEAM KIT – this kit enables you to make a switch that will trigger when a steady beam of infra-red or ordinary light is broken. Main components – relay photo transistor, resistors and caps etc. Circuit diagram but no case. Price £2. Ref. 2P15.
3-30V VARIABLE VOLTAGE POWER SUPPLY UNIT – with 1 amp DC output. Intended for use on the bench for experimenters, students, inventors, service engineers etc. This is probably the most important piece of equipment you can own. (After a multi range test meter). It gives a variable output from 3-30 volts and has an automatic short circuit and overload protection, which operates at 1.1 amp approximately. Other features are very low ripple output, a typical ripple is 3mV pk-pk, 1mV rms. Mounted in a metal fronted plastic case, this has a voltmeter on the front panel in addition to the output control knob and the output terminals. Price for complete kit with full instructions is £15. Ref. 15P7.
TRANSMITTER SURVEILLANCE (BUG) – tiny, easily hidden, but which will enable conversation to be picked up with FM radio. Can be housed in a matchbox. All electronic parts and circuit. Price £2. Ref. 2P52.

BARCLAYCARD VISA

EAST CORNWALL COMPONENTS

Access

1987 CATALOGUE available – range of components greatly increased – over 136 pages fully illustrated. Price £1.00 per copy (free upon request with orders over £15). Credit Tickets (3), Special Offer Sheets, Order Form and Pre-Paid Envelope. Order your copy now.

FEBRUARY SPECIAL OFFER 4-WAY EXTENSION SOCKET

COMPLETE WITH
3 METRE CABLE,
13A PLUG, FUSE
& NEON INDICATOR

NEW STANDARD SPECIFICATIONS

ONLY £4.50
NORMALLY £5.75

SPECIAL OFFER DRASTICALLY REDUCED PRICE 13A TEST PLUG

This device is extremely useful for testing your 13A sockets and telling you what, if anything is the fault.
Simply plug the test plug into the socket and observe the amber lights.

BT APPROVED EQUIPMENT

Master Socket (Flush)	**£2.90**	Wiring Tool	**50p**
Master Socket (Surface)	**£2.75**	Plug — 431A	**25p**
Secondary Socket (Flush)	**£1.90**	Slimtel Phone	**£17.35**
Secondary Socket (Surface)	**£1.85**	Viscount Phone	**£26.04**
B.T. Cable (per metre)	**15p**	Conversion Kit & Wiring Diag.	**£6.90**
Line Jack Cord with Plug	**£1.25**		
Extension Lead 5 Mtr	**£3.90**		

PANEL METERS

A comprehensive range of good quality, cost effective, moving coil panel meters. Cut-out required is 38mm. All plastic, black and white finish with four nuts and bolts. **Features:** All the meters have a mirrored scale i.e. reading can be taken from any angle. Illuminated face, by two built-in lamps. These require a 6V supply.

0.50μA	4K3	**PANEL/M1**	**£4.90**	0-1A	3R	**PANEL/M6**	**£4.90**
0.100μA	3K75	**PANEL/M2**	**£4.90**	0-2A	3R	**PANEL/M7**	**£4.90**
0.500μA	430R	**PANEL/M3**	**£4.90**	0-25V DC	196R	**PANEL/M8**	**£4.90**
100-0-100μA	1K1	**PANEL/M4**	**£4.90**	0-30V DC	196R	**PANEL/M9**	**£4.90**
0-1mA	196R	**PANEL/M5**	**£4.90**	VU Meter	196R	**PANEL/M10**	**£4.90**

BATTERY CHARGER (Universal Nickel Cadmium)

An attractive nickel cadmium battery charger ideal for charging the rechargeable batteries detailed below. The charger will charge all the sizes listed: AAA, AA, C, D and PP3 and up to four AAA, AA, C and D types and one PP3 can be charged at the same time. The charger has a hinged plastic dust cover for easy viewing. The five battery positions have L.E.D. 'charge' indicators. The unit also has a switch allowing batteries to be checked for current state of charge.

Power: 240V A.C.
Dimensions: 210 × 100 × 50mm
ORDER CODE
BAT CHARGE
1+ **£4.50**
10+ **£4.25**
100+ **£3.75**

Universal ni cd Battery Charger

Ni-CAD BATTERIES

AAA	**£1.25**	**£1.20 ea/10**
AA	**.90**	**.85 ea/10**
C	**2.10**	**1.90 ea/10**
D	**2.50**	**2.20 ea/10**
PP3	**4.10**	**3.90 ea/10**

SAFEBLOC

FOR QUICKLY AND SAFELY TESTING EQUIPMENT ON MAINS VOLTAGE, SIMPLY CONNECT WIRE TO CLIPS AND CLOSE LID. **£6.75**

RESISTORS – CARBON FILM 5%

1/4W 1RO to 10M (E12 Range)	**2p each. 15p/10. 75p/100**
1/2W 2R2 to 10M (E24 Range)	**2p each. 15p/10. 75p/100**
1W 10R to 2M2 (E12 Range)	**5p each. 40p/10. 3.00/100**
2W 10R to 2M2 (E6 Range)	**8p each. 60p/10. 5.00/100**

RESISTOR KITS – each value individually packed

1/4W pack 10 each value E12 – 10R to 1M 610 pieces	**4.50**
1/4W pack 5 each value E12 – 10R to 1M 305 pieces	**2.95**
1/4W pack Popular – 10R to 10M 1000 pieces	**6.50**
1/2W pack 10 each value E12 – 2R2 to 2M2 730 pieces	**7.75**
1/2W pack 5 each value E12 – 2R2 to 2M2 365 pieces	**4.70**
1/2W pack Popular – 2R2 to 10M 1000 pieces	**9.50**
1W pack 5 each value E12 – 2R2 to 1M 353 pieces	**13.75**
2W pack 5 each value E6 – 10R to 2M2 317 pieces	**21.75**

ADDITIONAL KITS

DISC CERAMIC 50V	125 pieces	**£3.50**
ZENER DIODES 5ea	55 pieces	**£3.50**
ELECTROLYTICS R.	100 pieces	**£7.25**
FUSES Q/BLOW 20mm	80 pieces	**£3.75**
FUSES T/DELAY 20mm	80 pieces	**£7.50**
PRE-SET POTS-H	120 pieces	**£6.75**
PRE-SET POTS-V	120 pieces	**£6.74**
NUT & BOLT	800 pieces	**£3.00**

EXTENSION MULTI SOCKETS

ALL 13A, FUSED WITH NEON INDICATOR

2-WAY	**£2.75 each £2.50ea/5**
3-WAY	**£3.80 each £3.50ea/5**
4-WAY	**£3.99 each £3.75ea/5**
PLUGS 13A 3-pin fused, white	**£0.46 each £0.42ea/10**

20mm FUSES

QUICK BLOW – 80mA, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1A, 1.25, 1.5, 1.6, 2, 2.5, 3.15, 4, 5, 6.3 **45p/10**
TIME DELAY – 50mA, 60, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1A, 1.25, 1.6, 2, 2.5, 3.15, 4, 5, 6.3, 10 **90p/10**

1" DOMESTIC MAINS FUSES

ALL 13A, FUSED WITH NEON INDICATOR
2A, 3A, 5A, 13A **£1.00/10**

1 1/4" QUICK BLOW FUSES

500mA, 1A 1.25A, 2A, 12A **50p/10**

SOLDER: 60% TIN 40% ALLOY

22g. Non-corrosive Multi-core Solder.
500gm Reel **£4.99 each** — 10 Reels **£3.75 each**

SOLDERING SECTION

Soldering Station complete with 30W or 40W Iron (state which)	**72.50**	CS 18W, as above	**10.90**
XS25 W Iron kit/complete with stand, 1m lead & plug attached	**8.20**	Antex 15W iron	**5.40**
CS17 Iron Kit	**7.99**	Antex 18W iron	**5.60**
C15 Iron Kit	**8.30**	Antex 25W iron	**5.80**
XS25 W Iron kit/complete with steel & plug attached	**11.00**	Antex elements	**3.20**
		Antex bits	**1.15**
		Antex stands	**2.20**
		Soldersucker	**4.50**
		Spare nozzles for Soldersucker	**0.65**

SERVICE AIDS

Goldklene Degreasing Solvent	**1.78**	Aero Duster	**1.55**
Switch Cleaner Lubri	**1.18**	Super 40	**1.94**
Supa Freeze-it	**1.46**	Rapid Fire Extinguisher	**3.45**
Foam Cleanser	**1.26**	Silicone Grease Tube	**1.82**
Video/Tape Head Cleaner	**1.14**	Silicone Grease Spray	**1.48**
Plastic-Seal	**1.40**	Heat Sink Compound	**1.20**
Aero-Klene	**1.16**	**Solda-Mop**	
Anti-Static Spray ellist	**1.28**	Light guage 0.08mm	**0.80**
Excel Polish	**1.24**	Standatd gauge1.2mm	**0.78**
		Industrial reel 1.2mm	**2.96**

ANOTHER SPECIAL OFFER

TEST PRODS (FUSED)

Manufactured by Bulgin.
High strength plastinc inc. 1A 1 1/4" fuse. Length of prods — red & black — 144mm.
99p Pair

DESOLDERING PUMP **£2.99**

SPARE NOZZLE FOR ABOVE — **60p**

PENSOL GAS SOLDERING IRON

Special price while stocks last only
£9.99
SPARE TIPS — 2, 4, 3.2 or 4.8mm **£3.50**

T.V. AERIAL ACCESSORIES

Co-Ax Cable 75 Ohm 100 Metre Reel **£12.50**	1+ 10+
Co-Ax Metal Plug	**20p, 18p**
Co-Ax Line Socket	**25p, 22p**
Co-Ax Line Connector	**12p, 10p**
Co-Ax In-Line Splitter	**80p**
TV/Video/Computer Combiner	**£3.09**
TV Indoor Amplifier Improves signal 3 times	**£13.66**
Second Set Amplifier Improves signal to 2 sets 50%	**£12.72**
CB Interference Suppressor Minimises CB interference on TV	**£4.45**
TV/FM Diplexer Separates UHF TV signals from FM radio signals	**£3.78**

MAINS SWITCHES

Single 1 Way (1 Gang 1 Way)	**0.85**
Single 2 Way (1 Gang 2 Way)	**1.20**
Twin (2 Gang 2 Way)	**2.00**
Triple (3 Gang 2 Way)	**2.85**

MAINS SOCKETS

13A Single Unswitched	**1.50**
13A Single Switched	**2.18**
13A Twin Unswitched	**2.50**
13A Twin Switched	**3.98**

VALVES

Enquiries are welcomed for any other valve not listed here.

Type	*Price (£)*
AZ31	**4.55**
AZ41	**2.05**
DAF96	**1.05**
DF96	**0.80**
DK96	**2.70**
DM71	**3.00**
DY86/87	**0.70**
DY802	**1.00**
CV850	**2.55**
CV4015	**2.85**
E180F	**6.55**
EABC80	**1.05**
EAF42	**1.55**
EB91	**1.35**
EBC41	**3.50**
EBF80	**0.80**
ECC81	**1.05**
ECC82	**0.95**
ECC83	**1.20**
ECC84	**0.85**
ECC85	**1.00**
ECC88	**1.45**
ECC189	**0.90**
ECF80	**1.25**
ECF82	**0.90**
ECF83	**1.95**
ECH35	**3.80**
ECH81	**1.45**
ECH84	**1.55**
ECL85	**0.80**
ECL86	**1.80**
EF80	**0.80**
EF86	**1.85**
EF91	**2.05**
EF95	**1.70**
EF183	**0.95**
EF184	**1.05**
EH90	**1.00**
EL34	**3.45**
EL36	**2.30**
EL81	**7.00**
EL84	**2.40**
EL85	**5.00**
EL86	**6.95**
EL509	**7.90**
EL519	**8.00**
EM80	**0.90**
EM84	**1.80**
EM87	**2.60**
EY51	**0.95**
EY86/87	**0.70**
EY88	**0.80**
EY500A	**2.55**
EZ41	**2.85**
EZ81	**0.85**
GY501	**1.45**
GZ32	**1.25**
KT66(G.E.C.)	**18.00**
KT77	**11.50**
KT88(G.E.C.)	**19.00**
PC88	**1.45**
PC92	**3.05**
PC900	**1.45**
PCC88	**0.85**
PCC89	**0.80**
PCC189	**0.90**
PCF80	**1.00**
PCF82	**1.00**
PCF84	**0.80**
PCF86	**1.30**
PCF87	**0.60**
PCF200	**2.00**
PCF201	**2.00**
PCF800	**1.25**
PCF801	**1.10**
PCF802	**1.10**
PCF805	**2.05**
PCF806	**1.25**
PCF808	**1.65**
PCL82	**1.05**
PCL83	**2.55**
PCL84	**1.05**
PCL86	**0.95**
PCL88	**2.55**
PCL805	**1.10**
PD500	**2.95**
PFL200	**1.90**
PL33	**1.55**
PL36	**1.80**
PL82	**0.80**
PL95	**2.05**
PL504	**1.55**
PL508	**2.75**
PL519/509	**5.30**
PL802	**5.55**
PY81/800	**1.15**
PY82	**1.80**
PY88	**0.85**
PY500A	**2.25**
PY801	**0.75**
UABC80	**0.90**
UAF42	**1.30**
UBC41	**4.35**
UBC81	**1.75**
UCC85	**0.80**
UCF80	**1.25**
UCH42	**5.65**
UCH81	**2.05**
UCL82	**1.85**
UCL83	**3.30**
UF41	**1.30**
UF89	**2.55**
UL84	**1.30**
UY85	**1.20**
2D21	**2.65**
6AT6	**1.30**
6AU6	**1.05**
6C4	**1.05**
6GH8A	**1.25**
6J5GT	**2.55**
6K7G	**2.05**
6K8G	**2.80**
6KD6	**6.55**
6X4	**1.55**
30FL2	**1.75**
30FL12	**1.65**

IDLER KITS/(REWIND KITS)

SHARP NIDL-0005 GE ZZ	SHARP-0012	**3.15**
0006	SHARP-0013	**3.50**
SONY SLC5/7UB	IK-01	**5.85**
SONY SLC6UB	IK-02	**4.70**

VIDEO HEADS

AKAI	ALL		**39.50**
FERGUSON	3V00/22/16/23/24/31/29/30		**39.50**
HITACHI	VT5000E		**38.00**
JVC	ALL		**39.50**
NAT/PANASONIC	VE and NV	FROM	**39.50**
SANYO		46.30 and	**50.60**
SONY	SLC 9UB/6/7/9/20/30/40/8000		**49.95**
TOSHIBA	ALL		**48.75**

SERVICE MANUALS

FIDELITY CTV 145/CTV140/R/CTV 2022	ALL	**2.75**
SONY KV1810UB Mk.1/KV1400UB	ALL	**8.15**
SONY KV2212/KV2705/KV2252	ALL	**5.85**
SONY SLC5UB/SLC6UB/SLC7UB/SLC9UB	ALL	**10.50**

VIDEO BELT KITS

NAT/PANASONIC	VDB01	**2.05**
JVC HR 7700	VDB02	**.40**
JVC HR 3360/HR3660	VDB04	**4.15**
SONY SLC7	VDB05	**2.40**
JVC HR3300/HR3320/HR3330/HR3600	VDBo6	**4.65**
SONY SL8000	VDB07	**6.75**
NAT/PANASONIC NV8600	VDB08	**1.55**
SONY SLT-7ME	VDB10	**.98**
SONY SLT-9ME	VDB11	**.98**
TOSHIBA V5470	VDB12	**1.45**
TOSHIBA V5475	VDB13	**1.56**
TOSHIBA V8600	VDB14	**4.50**
NAT/PANASONIC NV300	VDB15	**2.05**
SANYO 5500	SANYO-012	**2.05**
SANYO 9300	SANYO-013	**4.05**
SHARP VC381	SHARP-020	**3.15**
SHARP C6300	SHARP-021	**5.33**
SHARP VC7300	SHARP-023	**5.65**
SHARP VC9300	SHARP-024	**3.30**
SHARP VC9700	SHARP-025	**2.65**

BOOKS

DATA VOLUME 1 – Trans. data & drawings A-BUY	**£9.99**
DATA VOLUME 2 – as above C-Z	**£10.75**
DATA VOLUME 3 – 2N-2N6735	**£10.20**
DATA VOLUME 4 – 2SA & on	**£13.50**
DIODES VOLUME 1	**£10.75**
DIODES VOLUME 2	**£10.65**
Both Volumes	**£20.60**
I.C. CMOS	**£8.95**
I.C. TTL	**£19.50**
I.C. LIN VOLUME 1	**£6.95**
I.C. LIN VOLUME 2	**£6.99**
Both volumes	**£13.00**
THYRISTORS A to Z	**£10.45**
TRANSISTORS A to Z	**£5.40**
TRANSISTORS 2N-3N	**£5.50**
Both volumes	**£10.00**

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78L05	**0.28**
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BF183	**0.32**
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BF185	**0.28**
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BF195	**0.12**
BF224J	**0.20**
BF240	**0.15**
BF241	**0.18**
BF257	**0.22**
BF258	**0.26**
BF259	**0.30**
BF262	**0.34**
BF263	**0.38**
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TIP34A	**0.90**
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TIP42	**0.38**
TIP47	**0.60**
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IN4004	**0.05**
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IN5402	**0.12**
IN5405	**0.12**
IN5406	**0.14**
IN5408	**0.18**
2N2122A	**0.34**
2N2222	**0.30**
2N2904A	**0.48**
2N2926G	**0.14**
2N3053	**0.30**
2N3054	**0.80**
2N3055	**0.60**
2N3703	**0.14**
2N3773	**1.90**
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COVER PHOTO

This month's cover photograph shows Fidelity's new ZX5000 chassis which employs extensive digital signal processing circuitry. See article on page 273.

SKY CHANNEL

The accumulated deficit of Sky Channel's operating company Satellite TV Plc from 1981 to end June 1987 was £29·7m, not £44m as suggested in Teletopics, November 1987.

Sky's advertising income is rising with the growth of the cable and satellite industry in Europe and the company is confident of future profitability.

Goodbye '87

As I write this we are just into the new year. A suitable time to consider the state of the UK's TV industry and its prospects. But wait a minute: what industry? For 1987 was the year when the UK's last indigenously owned large-scale TV manufacturer, Ferguson, was sold to foreign ownership. It also seems to have been roughly the time when work on TV projects in the UK by Philips finally came to an end. This is not to say that TV receiver production in the UK has declined, quite the reverse in fact. With the announcement that JVC is to start production in Scotland, nearly every major Japanese setmaker now has a UK assembly plant, and substantial increases in the capacity of some of these plants were brought into production during the year. It's not only Japanese firms that have found the UK to be a favourable manufacturing base, as the example of Tatung shows. Now Goldstar, one of the two mammoth Korean producers, is set to join in. Though more TV sets and VCRs are imported into the UK than are exported, the percentage of imported sets has been declining in recent years. TV production in the UK has been on a rising trend, and from this point of view we could call it a successful industry. So successful that Japanese component manufacturers are starting up here as well.

This manufacturing activity is certainly helpful to the UK, creating employment and wealth. The Japanese are not doing it for fun of course. One of their aims is to ensure a manufacturing presence within the EC as a long-term insurance policy, and as far as TV setmaking is concerned the UK, with its history of TV manufacturing and large domestic market, seems to be seen as a suitable base. It could well be said that though the Japanese are obviously committed to UK TV production they don't make a lot out of it. Profitability has not been particularly good, which is why so many UK firms have pulled out of the industry over the years. But while profitability is regarded as the prime aim of UK owned firms the Japanese don't seem to consider it to be so all-important. They have the benefit of low-cost investment funds and are prepared to create plants and then go after market share. Turnover would appear to be the main consideration – though obviously not at an actual loss.

The high value of the yen has been one reason for the move by Japanese industry to off-shore bases. It's interesting that while the profitability of Japanese consumer electronics manufacturers was quite seriously hit by the initial yen appreciation in late 1985 and early 1986, it has subsequently been rebuilt. A rather different tale from what occurred in the UK when the pound rose to an unrealistically high value in the early eighties. Much of UK industry then simply capitulated, though the high cost of money must have made it difficult to do much else.

The Japanese manufacturer in the UK has the advantages of using low-cost funds (Japanese interest rates are amongst the lowest in the world) in a low-cost economy. The latter point is highlighted by the fact, brought out in a recent study on comparative international purchasing power, that while it takes the average UK employee 69 hours' work to buy a colour TV set it takes his Japanese counterpart 98 hours to do so. Does this mean that we are highly paid? Not so: in fact average earnings are markedly less. The important point is comparative price levels, and in this respect the UK economy is highly successful.

Does it matter too much that while the UK has a healthy TV manufacturing industry it's not domestically owned? After all, we benefit from the economic activity generated. It's worrying however that so little development work is now done in the UK, especially when you think of the past triumphs, from the 405-line system to teletext and MAC. But if indigenous UK firms won't carry out research and back it with production engineering capability leading to production programmes there's not a lot that can be done. As a nation we just don't seem to be orientated towards mass production technology. Maybe our education system has something to do with this.

As a sideline to the main argument, it's interesting to note that some of the ways in which Japanese firms go about market development seem decidedly odd in comparison with the established UK way of doing things. It's reported that Sony considers itself to be doing well if one in ten new products is a success. The Japanese appear to be prepared to make and market new products to see whether they find public acceptance rather than carrying out extensive market research, though they do carry out long-term planning on products likely to produce large markets. This approach would probably be seen by the average UK manager/director as wanting in terms of cost consciousness, but at the end of the day what it boils down to is that the Japanese have production know-how and entrepreneurial flair in the manufacturing field while the UK doesn't.

So 1988 sees a thriving TV industry in the UK, but an impoverished technical back-up. A pity, but until engineering skills are accorded a higher place in our priorities we shall just have to live with it.

INDEXES

We apologise for the delay in making available the indexes to Volumes 36 (1985-6) and 37 (1986-7). The index to Volume 36 has now been printed and copies are available from the Editorial Office (for the address see page 241) for 80p each inclusive of postage. In addition the index to Volume 35 (1984-5) has been reprinted. Indexes to earlier Volumes are no longer available. The index to Volume 37 has been compiled and will be printed shortly. An announcement will be made when copies are available.

Long-distance Television

Roger Bunney

I continue to receive reports on the excellent tropospheric opening that occurred at the beginning of November, when last month's column was being written. Unfortunately November was an otherwise relatively bleak month for DX-TV reception. Even the mid-month Leonids meteor shower did little to boost one's morale – there was just a slight improvement from the norm in the diurnal rate.

The previously mentioned tropospheric opening lasted from November 3rd through to the 8th, when it fizzled out. What was significant during the event was the Band III ducting, which produced signals from East Europe. Quite simple aerial installations enabled signals from CST (Czechoslovakia) to be received in Band III and at u.h.f., confirming once again that under the right conditions an efficient aerial installation will produce DX reception – and by efficient we don't mean a vast, dominating aerial system!

The best reception seems to have been during the 6th/7th, when central European signals reached Wales and the northern UK. Signals from transmitters in West and East Germany, France, Holland, Belgium, Luxembourg, Denmark and Czechoslovakia were received at good strength. Several enthusiasts report reception of TVP (Poland). Cyril Willis (Norfolk) for example picked up TVP chs. R36 and R36 at mid-day on the 5th. In Rugby Nick Brown received CST ch. R38 and Mark Baldwin CST Plezen ch. R10. Earlier Mark, using an indoor installation consisting of a Colour King u.h.f. aerial and a set-back preamplifier at Rushden, Northants, found that the u.h.f. bands were "full of FUBK test patterns from Germany". Reception of DFF (East Germany) chs. E5, 6, 12, 31, 33 and 34 was reported by Mark back in Rugby on the 6th. Further to the west, in North Wales, Simon Hamer (Powys) received French stations on all the Band III and 27 u.h.f. channels, 31 W. German stations (networks HR, NDR, BR, WDR and ZDF) in Band III and at u.h.f., and DR (Denmark) ch. E10. Both the AFN and the BFBS were heard in the f.m. band. In Birmingham David Oliver logged many of the above stations plus several French TV5/M6 transmissions. Ryn Muntjewerff reports good reception in Holland, though his letter covers only up to the 4th, with Grunten ch. E46 in the far south of Germany and CST/DFF stations in Band III and at u.h.f.

Gosta van der Linden logged the sound and vision signals from many CST transmitters on his Grundig receiver in Rotterdam, Holland. He supplied the following list which may be helpful for identification purposes:

ch. R22	Klatovy-Barak	100kW
ch. R23	Trutnov-Cerna Hora	1,000kW
ch. R24	Praha Mesto-Petrin	100kW
ch. R31	Liberec-Jested	100kW
ch. R33	Usti nad Labem	600kW
ch. R35	Susice-Svatobor	100kW
ch. R36	Cheb-Zelena Hora	100kW
ch. R37	Frydek-Mistek	300kW
ch. R38	Jackymov-Klinovec	300kW

– powers e.r.p., polarisation horizontal in all cases. Gosta mentions that if you are lucky you might receive from West Germany the "Senderdia", a locally generated (i.e. at the transmitter site) test pattern. This is transmitted when the network link fails or is interrupted, when teletext also ceases. These identifications are rare but do occur from time to time over the ZDF and ARD-3 networks.

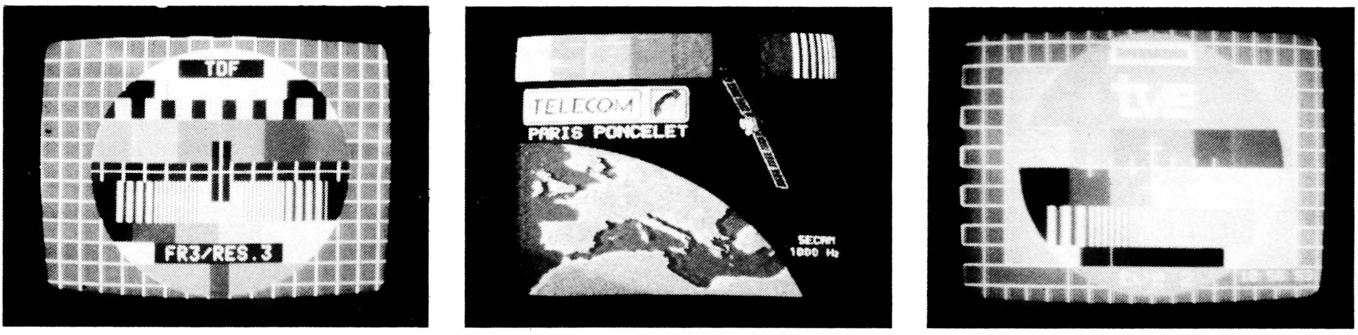
Although this tropospheric opening was the main event of the month, overshadowing other reception, there was still some Sporadic E propagation. Here's the collated SpE log:

4/11/87	TSS (USSR) chs. R1, 2, 3 (Leningrad identified on chs. R1 and 3).
8/11/87	TSS R1.
10/11/87	TVE (Spain) E3.
15/11/87	TVE E2, 3; RAI (Italy) IA; CST R1; TVP R1.
18/11/87	CST R1; TVP R1.
19/11/87	TSS R1; TVE E3; RAI IA; RTE (Eire) ch. B.
20/11/87	TVE E2, 3; RAI IA.
22/11/87	RAI IA;TVE E2; unidentified late-night programmes on chs. R1 and 2.
26/11/87	TSS R1; SR (Sweden) E2, 3, 4.

Note that RAI is now known as RAI-UNO.

My thanks to David Oliver (Birmingham), Cyril Willis (Norfolk), Simon Hamer (Powys), Iain Menzies (Aberdeen), Ryn Muntjewerff (Holland), Gosta van der Linden (Holland), Roger Fussell (Torpoint), Mark Baldwin (Rugby) and Nick Brown (Rugby) for sending in reception reports.

The RSGB's VHF/UHF Newsletter for December 1987 contains an excellent article by Ken Osborne entitled "Auroral Propagation", giving a detailed account of



Left: FR3 (French) test pattern received by James Burton-Stewart. Centre: Telecom downlink test transmission, also courtesy James Burton-Stewart. Right: TVE (Spain) test pattern received by Hugh Cocks in Portugal, on ch. 45 at a distance of approximately fifty miles.

auroral propagation with specific reference to how this phenomenon affects the UK.

A DXer recently noticed leakage from the cable TV system at Stevenage. In some areas it was possible to resolve clear pictures using a hand-held portable in the street. Distribution around the town is at 48·5MHz Anglia, 61·74MHz BBC-2, 174MHz Sky Channel, 183·1MHz BBC-1, 193MHz Super Channel, 206·75MHz ITV London, 216·13MHz Channel 4 – the vision carrier frequency in each case.

News Items

Hungary: The government has announced an "open skies" policy regarding DBS reception. The local PTT will handle all licensing and reception of satellite cable system downlinks will be discouraged.

New Zealand: The first private New Zealand TV network is to be known as TV-3. The franchise being offered will cover all four regions plus a fifth overall franchise to provide the programme service. Since most of the v.h.f. channels available are already in use it's possible that u.h.f. will for the first time be used for TV in New Zealand. One problem is that until recently receivers sold in NZ have not been fitted with u.h.f. tuners. Difficulties are expected to arise with the BCNZ over the use of common microwave links for network operations.

Norway: Trondheim now has BBC reception via satellite and cable distribution for some eight hours daily (1600-2400) – further hours are promised. Other towns are to follow suit. It seems that BBC programming is very popular in the Nordic region.

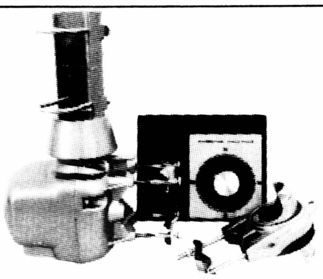
Japan: With the BS-2B satellite now in operation and NHK providing a 24-hour TV service there's a boom in the sale of TVRO equipment. The BS1-TV service carries extensive news information gathered from NHK, ABC and CNN for some eleven hours daily, followed by films and sport later in the day. The sound system is bilingual (Japanese/English). The BS2-TV service transmits for eighteen hours daily, with repeats from the terrestrial NHK transmissions: separate programming for BS2-TV is to follow later. All the well-known electronics manufacturers are selling DBS equipment, which is available at prices down to the $400 (US) level.

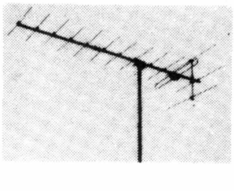
Australia: The government is to auction new commercial radio licences and to charge a.m. stations converting to the popular new f.m. band a large fee.

From our Correspondents . . .

Frank Lumen, now living in Denver, Colorado, flew back to Gatwick on October 27th. During the flight, while at 50°N just south of Greenland, he saw the Northern Lights (an aurora) for the first time. He writes that "it appeared as a white glow extending from the horizon to 10° elevations off the horizon and almost 180° from west to east". The plane was flying at 37,000ft a.s.l.

Welsh enthusiast Stuart Jones has been experimenting with satellite TV receiving equipment. He writes that locking a local sync processor to the incoming weak video signal gives a greatly improved video display: with the processor in circuit RTL Luxembourg, which is a very weak downlink signal, improves to clear caption readability. The same technique used with scrambled signals such as Filmnet and Sky enables a stable image to be displayed: the local master oscillator is phase locked to the scrambled key pulses (2·5MHz line sync on Sky's f.m. subcarrier, 6·5MHz with Filmnet). A MAC coded signal (the Norwegian C-MAC downlink) can be similarly





AUTOMATIC
ANTENNA
ROTATOR

FERNSEH-ANTENNA
High Gain Wideband
VHF Band 3 Aerial
for TV DXing

Special Seasonal Offer – We have recently advertised the above two items separately at special prices. This month we are again breaking our own price barrier – the automatic antenna rotator is now only £38, and the S1814 Band 3 high gain aerial is down to £28. If the two items are purchased together, the total price is only £64 an even further saving.

The rotator is ideal for **DXing**, Amateur and domestic use to turn your aerial for reception of alternative ITV regions. The system comprises of two major components, the automatic control consol and the rotator head unit. The additional support bearing shown, may be fitted if larger multiple aerials are to be fitted. The attractively styled Control Consol features continuous indication of aerial heading, showing the aerials position at all times. The rotator support mast can be up to 2" in diameter, stub/rotation mast is up to 1½" in diameter.

The Fernseh-Antenna pictured is a 14 element high gain (11.5dB) wideband array covering all VHF channels in Band 3 (175-230MHz). The aerial is gold lacquered for complete protection from corrosion, has a folded dipole for peak efficiency and comes complete with plated mast clamp, which has a 2" grasp capability.

COLOROTOR Automatic Antenna Rotator and Control Consol (uses 3 core control cable)	**£38.00**
SUPPORT BEARING for heavier load applications	**£17.00**
FERNSEH-ANTENNA S1814 High Gain 14 element Wideband 3 Aerial	**£28.00**

(Carriage & insurance on aerial £4.95)

If Rotator and Antenna are purchased together, total price is £64.00 + Carriage.

Aerial techniques is the company that knows the TV-DXing hobby. We carry a large and comprehensive range of aerial equipment for every type of installation, together with a vast range of filters, amplifiers, cables, rotators, masts and supporting hardware. Send today for a copy of our glossy covered illustrated **Catalogue at 75p**, in the unlikely event that is doesn't list what you want, we can obtain it quickly.

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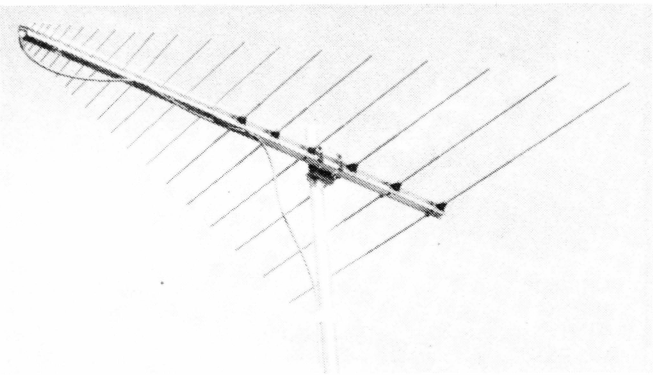


The CLP5130-2 wideband log-periodic aerial available from Waters and Stanton, covering 105-1,300MHz.

locked, though only in monochrome and with an elongated picture.

The 50MHz Amateur Band

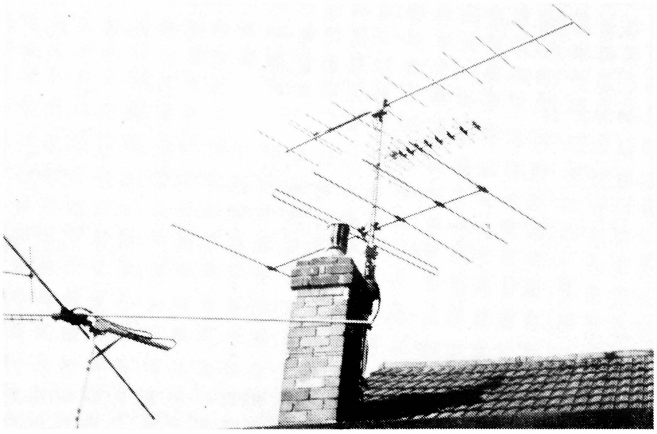
We understand that from April 1988 Dutch amateurs will be able to use the 50-50·45MHz band, running c.w. (morse) at up to 30W output. The Ascension Island has also been given this allocation, with powers up to 50W.

Scrambling

The BBC has completed tests for the proposed night-time subscription TV service. Many queries were received concerning the scrambled picture and the BBC eventually added a caption over the scrambled video display to indicate that a test transmission was taking place.

The UK TVRO fraternity has been showing much interest in the scrambled offerings of the Dutch Filmnet service. Decoders appear to be available in the UK and have been advertised. It seems however that use of such decoders could give rise to problems apart from that of legality. The Matsushita scrambling system has a 32-mode operating code. It's intended to operate for a period in one mode then change to another and so on. This is to frustrate the decoder user and manufacturer who, faced with these changing modes, is expected to give up! Once the 32 modes have been used to the full the idea would be to introduce random variations within the modes.

There's much interest in Canal Plus scrambling amongst enthusiasts along the south coast – we've received a number of requests for information on sources of suitable decoders. Since Canal Plus does not allow UK viewers to subscribe to the service decoders are not available officially. We understand however that decoders can be obtained, at a cost of around £300, for feeding into the scart socket of a suitable System L receiver. If anyone is seriously interested, write in with a s.a.e.: requests will be referred to source. It's assumed that suitable arrangements would be made with Canal Plus (78 Rue Olivier de Serres, 75015 Paris, France).



Mark Baldwin's aerials at Rugby. On the chimney, wideband arrays for Bands I/III and u.h.f. In the foreground, the classic Band I omnidirectional X array.

New Products

The well-known amateur and general radio dealers Waters and Stanton (18-20 Main Road, Hockley, Essex SS5 4QS – 0702 206 835) have introduced an impressive looking log-periodic aerial, Model CLP5130-2, that covers the spectrum 105-1,300MHz. The twenty-element design has a forward gain of 11-13dBi (that's dB gain isotropic, i.e. a gain of about 8·5-10·5dB with reference to a half-wave dipole) and a front/back ratio of typically 15dB. The aerial is shown in the accompanying photograph and weighs 3kg. It can be clamped either vertically or horizontally to a 2in. o.d. mast. Both the boom and the longest element are only 1·4m long and the output impedance is 50Ω via an N socket.

The aerial has a flattish gain over the designed-for bandwidth and the characteristics generally remain constant within this bandwidth. The support boom operates as a balanced feeder with successive dipole elements fed in antiphase in the usual log-periodic manner. It's generally accepted that if a metal support mast protrudes through a log-periodic array there's a gain loss over the bandwidth handled by the section behind the mast – the mast causes an imbalance within the balanced feed system. The use of a non-metallic support mast, e.g. fibreglass, is thus recommended. I'd like to hear from anyone with experience of log-periodic aerials with a view to obtaining information on problems, results, etc. The CLP5130-2 costs £82·50 inclusive of VAT. We understand that the manufacturers also have available a model covering down to 50MHz. This might be of greater interest to TV-DXers but is not at present being imported. If enough interest is expressed however Waters and Stanton have agreed to consider importing this model – the price would inevitably be higher than that of the 105-1,300MHz version. Please include an s.a.e. with any enquiries.

Some years ago South West Aerials, now Aerial Techniques, sold a number of Redson multi-standard colour receivers. When stocks were exhausted these became much sought after and are now rare birds indeed. Fret no more! Aerial Techniques tell us that they can now supply a 14in. PAL/Secam colour receiver with full System B/G/I/L (French) capability covering Bands I/II/III and u.h.f. including the "in between" S channels. The low v.h.f. band covers 48-113MHz and the high v.h.f. band 119-294MHz. The u.h.f coverage is 470-861MHz. Tuning across the v.h.f. bands is continuous. Quite a remarkable v.h.f. coverage!

For the record low v.h.f. includes cable channels SS1, SS2, SS3, S1 and S2: high v.h.f. continues from S3 to S10 then E5 through to E12 followed by S11 up to S20.

The receiver has infra-red remote control, a scart socket for baseband vision and sound, 16-memory tuning plus up/down search control and switchable a.f.c. It's seemingly the all singing, all dancing receiver for colour TV-DXing and costs less than £300. I've not yet seen one myself but understand that the gain is hot. Enquiries with s.a.e. should be sent to Aerial Techniques whose advertisement accompanies this article.

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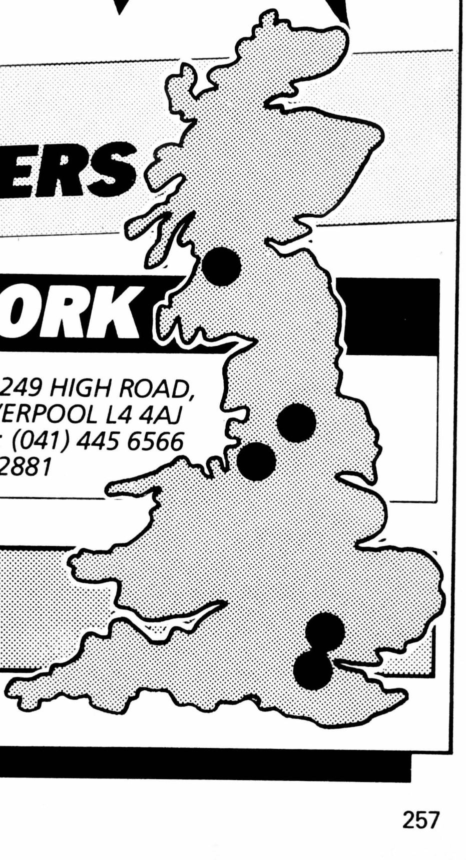

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G8 Transductor	**£1.25**
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Vintage Scene: The Kinemacolor Film System

Chas E. Miller

"Blue-violet, green and red are the known primary colours of the spectrum, because with them one can produce any of the other colours, white as well. If these three primary colours are on the same part of the same screen we see a disc of white. Cut off the blue-violet and we get yellow-orange. Cut off the red and we see blue-green."

These words might well have come from a quite recent book on colour television but were in fact written well over seventy years ago as the preamble to a description of how moving pictures in colour were made at the close of the Edwardian era. It might seem curious that even less than twenty years ago some films were still being made in black-and-white, as is evident from their appearance on TV nowadays, despite colour stock long being available in various forms, but cost had something to do with it and of course monochrome actually aids rather than detracts from the impact of certain types of film. No doubt the early colour pioneers expected their systems to oust the black-and-white movies in rather less time than the half century it actually took!

Rather surprisingly, the Kinemacolor process used monochrome film stock to provide a fair representation of natural colour. At the time most films and plates were of the orthochromatic type, which was insensitive to red and orange light. Panchromatic stock, which overcame this deficiency, had just appeared and it was this that made colour simulation possible. The normal silent film speed was sixteen frames per second, but the Kinemacolor camera ran at twice that speed, with a colour filter disc revolving in front of the lens at half shutter speed. One half of the filter carried a red glass disc, the other half green. Thus each scene was captured by two separate frames of the film, one taken via each of the two filters.

To give a simple example, suppose the camera was filming a young lady in a red coat, carrying a yellow bag and standing on a well-maintained lawn. With the red filter in front of the lens light reflected from the red coat would pass through to the lens without serious interruption but most of the green from the lawn would be blocked. The reverse happened with the green filter in front of the lens: the red was attenuated but the green was freely admitted. In both cases the yellow from the bag would not have been affected seriously.

When the film was developed each pair of frames provided negatives with opposite characteristics. Those coming via the red filter showed the coat as black and the grass as white, while via the green filter the coat was white and the grass black. In each case the bag was grey. A positive printed from these negatives once again reversed the tones, so that in the film made ready for projection the first frame showed a transparent coat and an opaque lawn, the second an opaque coat and a transparent lawn. The bag was half-transparent in both frames.

Projection

During projection another filter rotated in front of the lens to "decode" the twin positives. This second filter had red and green segments plus two others of somewhat smaller size and of transparent glass to help achieve a better colour balance. When the red positive was projected the screen received flashes of red light for the coat, virtually no light for the lawn and a low-intensity light for the bag. The green positive gave bright green flashes for the lawn, little light for the coat and half-intensity for the bag. Due to that well-known phenomenon the persistence of vision, viewers saw an impression of the original coat and lawn colours, plus the bag made up from additions of red and green light. This is clearly a very crude example: in an actual film each pair of frames contained a tremendous amount of opposite-colour detail.

It will be apparent that projection of the finished film on to the screen presented the same problems of synchronisation, colour registration and purity that apply with colour television. The first two were tackled primarily by the film cameraman and processor, the third by the projectionist.

Registration and Synchronisation

Ensuring that each pair of frames had exactly the same picture content was a matter of having a rock-steady camera mounting so that there wasn't the slightest danger of vibration etc. to produce tiny differences in the field of view as the film passed behind the lens. With the huge magnification of the final images on the cinema screen any inaccuracies would show up just as misconvergence does on a colour c.r.t. Even more serious would be errors in the timing of the projector's filter disc. For the colours to be reproduced convincingly it was essential for the filter disc to run exactly in step with the film.

Mechanical synchronisation was provided by having the original negative stock marked in a special way for the camerman, then duplicating the marking on to the positive for projection. At the start of a reel seven small holes were punched in the film, followed by a larger hole of D section. The cameraman had to arrange the film so that the D hole corresponded with the red filter being in front of the lens. The same procedure was used at the projector, so that the rest of the film then went through the gate in step with the filter – all operations were performed by gears with constant speeds in relation to each other (if the film should happen to break it would be a different story!).

Purity Correction

Colour purity was corrected by the projectionist before each performance. You might by now be wondering how white was produced using only red and green primaries. In fact however the green filter was bluey-green and the light source itself (a carbon-arc lamp) contained much blue. Thus the alternate red and blue-green lights from the projector did approximate to white on the screen when the machine was running with no film passing through the gate. Final balancing was done by varying the density of the green filter. This entailed fixing extra glasses over the permanently fitted one until the best white was obtained.

Outcome

Kinemacolor was not the runaway success that was hoped for, probably because of the expense (twice as much film stock was required per subject than with monochrome) and the headaches that must have been caused in exposing, processing and then projecting the film in exact synchronism in the face of the inevitable breaks that occur from time to time. Anyone who has worked a projector knows that the older the print the more "jump-cuts" there are likely to be. If these were accompanied by sudden colour reversals the effect must have been quite striking!

The eventual development of the Technicolor process sealed the doom of Kinemacolor, but its principles were resurrected for use in the CBS colour TV system of the late forties (filters running at high speed in front of the set – very dodgy!) and in some colour TV equipment used in early space flights. Dr. Edwin Land demonstrated how the same system works equally well with a still camera, and anyone can conduct some fascinating experiments with an ordinary camera and a couple of filters, using monochrome reversal film. In the usual order of things, the system is probably due to be "rediscovered" any day now and hailed as a major breakthrough!

Letters

COST OF IN-GUARANTEE REPAIRS

What do large manufacturers really offer the small shop when their products fail after being sold to the public under guarantee? Some manufacturers pay a set fee for each item repaired, provided they are supplied with the serial/product code and you send them the faulty component. Not all manufacturers will do this: most will repair a faulty product if it's sent back to their service centre while others will send out their own service engineers to repair the product in situ.

What does a faulty set cost the small retailer? To start with his time is taken up in dealing with the complaint and filling out a job sheet. Next an engineer has to be assigned to go to the customer's house and either repair the set or return it to the workshop for repair, in either case a time consuming and expensive liability. If bench work is required an engineer's time has again to be allocated, then the set has to be returned to the customer's house. In the meantime it will have been necessary to provide the customer with a loan set installed free of charge, i.e. tune it in, explain how it works, make excuses for the faulty set and so on. Eventually the repaired set has to be reinstalled. If the set has an intermittent or difficult fault it will probably have been returned to the supplier for repair. In this case someone has to parcel up the set, write out a fault report and packaging note, then telephone the suppliers to arrange for a pick-up. Anything up to a month or more will then elapse before you see the set again, hopefully fully repaired although this is not always the case. This is all very expensive and time consuming and is hardly recompensed by the small fixed payment that some larger manufacturers make to the retailer.

In addition to this the retailer has to pay for any telephone calls to the manufacturer's technical department. The chances of actually getting through are becoming more and more rare. You usally end up dialling the switchboard and being told to hold the line while other calls are being dealt with. Note that as soon as the telephone is picked up at the other end you have to start paying for the call, which can soon prove to be very expensive. With some firms you can be dialling all afternoon before you get a reply.

If you don't have an account with the manufacturer you often have to pay for any service manuals required. This has become a boom industry: some manufacturers charge anything up to £40 for a complete manual.

These points all come into the equation when the final profitability is worked out. The retailer is in many cases unwittingly deceived by what at first glance looks like a simple product sold = profit made equation. In addition, provided huge numbers are not involved, the manufacturer gets very little come-back when a product fails. The retailer however has to bear the cost of call-outs, telephone bills, packaging, loan stock overheads, petrol, his service department – and any loss of good will.

In view of all this retailers should be wary to avoid being hoodwinked by manufacturers into bearing the time/expense bill for handling their defective products.

Peter Ellis,
Prince TV Services, Wem, Shropshire.

VCR SERVICING CHARGES

Having serviced nothing but VCRs for five years before leaving the industry a year ago I'd like to suggest that the difficulties of servicing standard VCRs are becoming a bit exaggerated. Steve Beeching's letter on specialist items such as camcorders and video cameras is quite correct – I've never repaired or wanted to repair such equipment. There's a possibility however that the cost of specialised equipment could be passed on to those simply wanting a standard VCR to be serviced. To suggest that £50-£60 is the minimum viable cost of carrying out a repair unless the fault is a common one could give the impression that most faults should cost this much, which is just not true.

I had to repair six-eight machines a day – twelve at busy times. This involved carrying out the repair in the customer's home where possible, otherwise doing the repair in the workshop first thing in the morning before leaving to do the calls. It became clear that if a repair was going to take more than thirty-forty minutes or so, or required the use of a meter or oscilloscope, the job was best done in the workshop. Despite this over half the calls could be dealt with in the field. Such faults consisted of things like head cleaning, fuse and belt replacement, tuning, jammed tapes and known stock faults. Machines brought into the workshop didn't necessarily have difficult faults: often it was simply the case that the spares required, e.g. heads, aerial sockets and boosters, were not carried in the van. Heads were occasionally changed in the field if I knew in advance that this was the cause of the fault.

The remaining machines, perhaps ten per cent of the total, were the difficult ones that had either intermittent faults or colour/servo problems requiring the use of an oscilloscope or frequency counter.

This brings me to the subject of test equipment. During my five years servicing VCRs I never needed much more than an Avo 8, an oscilloscope and a frequency counter – the latter was used almost exclusively for setting up the oscillators in Mitsubishi machines. In the early days an alignment tape and jig were also required, particularly for Ferguson 3V22s, but in the last couple of years, as the alignment of new machines improved, a known good colour tape recorded on one of these machines sufficed.

Betamax head replacement was an exception, requiring the use of an eccentricity gauge. The scope was a dual-beam one, but the only times when both beams were used was for speeding up the diagnosis of intermittent faults by monitoring two points at once.

Most of the machines were under guarantee or on rental. Treating them all as chargeable would however suggest the following costs: in 50-60 per cent of cases £20 plus parts plus VAT (parts usually less than £10); in 30-40 per cent of cases £25-£30 plus parts plus VAT (parts less than £20 except for heads and motors); in less than 10 per cent of cases more than £30 plus parts plus VAT.

Derek Snelling,
Brownhills, Staffs.

TV SERVICE CHARGES

In reply to L. Goodwin's letter in the December issue, when a G11 comes into my workshop for replacement of the parts specified my action would be as follows: replace the TDA2600 chip and its holder, the two 1·5kΩ resistors and the 470μF electrolytic; solder all the known dry-joints and check for others; clean the tuner contacts, and finally polish the cabinet and the tube face. For this I charge £40 which includes parts, labour and VAT, also if local collection and delivery. I give a twelve months' written guarantee.

As far as second-hand sales are concerned, at the time of writing we sell *fully* reconditioned G11s at £75 for Philips models and £95 for Pye models (electronic tuner buttons and square cabinet). All with twelve months' written guarantee. VCRs are sold on the same basis.

Eric Edwards,
Barry, South Glamorgan.

VIABILITY OF SERVICING

As a TV engineer who left the trade in 1981 I was interested in the recent letters on the viability of TV servicing, particularly those from Steve Beeching and L. Goodwin.

Steve Beeching really put his finger on the problem in commenting on the availability to the public (and we are all part of this group) of cheap high-technology goods and the high cost of servicing them. As far as repair charges are concerned it's all relative. We all know the famous phrase "there can't be much wrong with it, probably just a wire off", implying at the start that the bill is not expected to be too high. But even when the fault is found and rectified a certain amount of time has to be spent on setting up and soak testing. An average time of three hours per set at only £10 an hour, plus materials, will often result in a £40 bill. How would L. Goodwin explain this to the customer who bought the set for £50 only seven months ago?

Let's assume that L. Goodwin got a set from the depot for say £30. Transport costs and time to collect have to be taken into account, then time is required to go through the set for stock faults, preventive servicing and setting up. Assuming a nil material cost, an average time of an hour spent on the set is not unrealistic. At our suggested hourly rate this brings the unit cost to £40 which, plus VAT, amounts to a total of £46. Difficult to see where L. Goodwin gets his £25-£30 profit from. And don't forget that warranty cover is unknown at this stage. I don't think that even £90 is unreasonable for a good quality G11 or similar set.

On the subject of free estimates, my own experience

next month in

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● FAST-SHUTTER VIDEO CAMERAS
Video cameras and camcorders fitted with shutters have become available in recent times. This has been made possible by the use of solid-state image sensors and gives improved definition with fast-moving subjects.
Eugene Trundle describes the operation of CCD image sensors and the fast-shutter mode of operation.

● DIGITAL STEREO SOUND SYSTEMS
In the concluding instalment of his series on dual-channel sound systems Geoff Lewis describes the various systems proposed or specifically developed for TV use, including Dolby ADM, MAC Packet sound channels and the NICAM 728 system which will be used for terrestrial broadcasting in the UK.

● THE ART OF FAULT FINDING
A sound technical knowledge doesn't necessarily guarantee success when it comes to efficient fault diagnosis. In fact the man with plenty of theory can get too interested in circuit detail. Much can – and should – be done before any test equipment is brought into use. This is where the art lies, as B. A. Berry explains.

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suggests that this is by far the best way of operating. I found that is was very rare for a customer to turn down an estimate. One has the psychological advantage of being in the house with all the bits and pieces required, but the customer is always free to refuse the estimate and try elsewhere.

It's interesting to see this hoary old chestnut make its appearance again. I'm always reminded of the relative costs of the colour TV set and the van it's delivered in. Compare the prices in 1968 and today: the TV set has come down in price while the van costs four times as much.

Why did I leave the trade? Because of this sad situation. With the cost of setting up in business, particularly in the affluent south, the proposition is no longer attractive, especially if you have expansion in mind.

Incidentally the G11 with field collapse would cost about £20 without a call out, £35 with (this assumes no general setting up or preventive servicing of course). I believe that the subject goes deeper than this however: it involves good customer relations and building up a good, solid reputation, even if this means doing the occasional free call when there should have been an extra bill.

Finally, it's unwise to generalise about "get rich quick" cowboys. My own experience suggests that they are in the minority. Most of the engineers I've met have been straightforward, honest people, interested in the problems rather than the cheque at the end of it all.

George Bloomer,
ACES, Southampton, Hants.

PHILIPS VR6462 MODIFICATION

Tape looping in forward search is a problem we've had with several Philips VR6462 VCRs. I've devised the following modification to cure the trouble. If looping persists after replacing the reel idler wheel and cleaning the associated drive surfaces add a 10Ω resistor across R3101 and R3103. These two resistors are both 10Ω and are connected in parallel between the wind motor and pin 3 of IC7101-2A. They sit at the top of the rear panel, P603, which doesn't even have to be removed. I've carried out this modification in several of these machines and have found that it completely clears the problem.

David Hall,
Aberdeen.

SPECIALISATION IN THE SERVICING TRADE

When we take a service van into one of the larger garages today we often find that it goes to specially equipped bays for servicing specific subsystems such as the engine, suspension, steering etc. This arrangement has its origins in North America – in the UK we are still a few years behind in this respect. When our Canadian cousins need to have their van serviced this often means a visit to several specialised units, perhaps even in different streets. If the gear box is faulty you go to the Transmission Shop, while a blown silencer involves a visit to the Muffler Shop. If servicing in the UK TV trade reached this state we might just find that the customers' bills are somewhat higher!

Larger rental companies already split their service departments into TV, video and audio sections. This has a certain logic about it, but when it comes to the provision of expensive and specialist test gear you can find that some items have to be either duplicated, which is costly, or made available to the various sections simultaneously. The latter approach also presents problems since no one seems to be responsible for particular items and they are never where they should be when needed.

Steve Beeching's approach of concentrating on video work and not getting involved with TV repairs could lead to the situation where a customer takes his VCR to Steve, his TV set somewhere else, and is told that both are in good working order. I have a feeling that there are too many strange interface problems today, even with items of domestic equipment, for it to be possible to take such an isolated view of servicing. In this connection a vectorscope may be essential for work on video cameras, and can also be useful in the VCR bay, but is it fully employed? It might have even greater value if TV was part of the stock in trade.

Geoff Lewis,
Canterbury, Kent.

A DETERRENT TO THEFT

In the March 1987 issue Roger Bunney asked for ideas on preventing or deterring the theft of equipment. I suggest that manufacturers should consider wider use of the system used with some car radios. If one of these is disconnected from the battery, i.e. power source, a code number has to be entered before the radio will function again. Failure to enter the correct code, similar to that used with "hole in the wall" money machines, results in the radio locking up for a considerable period of time – which cannot be shortened by outside interference in an attempt to have another go at entering a number.

For indoor equipment a code number, either factory programmed or programmed by the user, could be entered on resumption of power. Failure to enter the correct number would result in the unit having to be returned to the manufacturer for attention. Anyone who has a unit stolen would be able to alert the manufacturer, giving the equipment's serial number.

Whilst this wouldn't prevent theft or result in equipment being returned to its owners I feel that the system would have a strong deterrent effect since, in effect, the equipment would be useless to anyone except the authorised user.

I understand that thefts of car radios fitted to certain cars – no names! – have dropped considerably since these coded radios were fitted. I have myself legitimately fallen foul of the coding system, and can assure you that waiting for a unit to "time out" is both very boring and a deterrent to any attempts by trial and error techniques to find a partly forgotten, let alone unknown, code number.

Most domestic electronic equipment these days seems to have a digital system somewhere within it, so it shouldn't be too difficult to add such a code or similar system.

R.P. Harris,
Shrewton, Salisbury.

VIDEO MATTERS

In connection with my reference to Panasonic 3·3F, 2·2V memory back-up capacitors in the December VCR Clinic I'd like to make a small correction which I'm sure everyone realised – NV333 onwards should have read NV366 onwards as the NV333 doesn't have memory capacitors.

Eugene Trundle mentions the Panasonic VW-AMC5E/B power supply/charger. I think several engineers will have had my experience of similar troubles with earlier units of the same type, i.e. randomly failing thermal fuses. Units made during the first few months of a production run seem to suffer from this problem, the later ones generally being o.k. – this seems to have been the pattern since the VW-A18 for the NV180B.

Finally, my wholehearted agreement with Steve Beeching's comments on servicing policy. I envisage that dealers will increasingly subcontract their servicing to specialist organisations that have the necessary equipment available. I would hope that these organisations will take the form of local area companies supported by the various manufacturers.

Nick Beer,
Bideford, Devon.

SPARES FROM MASTERCARE

Nick Beer mentions (letters, December) that spares for Saisho, Triumph and other Currys/Dixons brands are available from Mastercare. The trouble is that Mastercare do not supply goods at trade prices, only retail. So be warned. Here are some recent examples: LOPT for a Siemens colour TV set sold by Dixons with spares available only from Mastercare, £59·82 inc.; front cassette housing flap £5·70 inc., same from Panasonic £1·39 inc.; reel motor for a Triumph VCR (same as Amstrad) £31·63 inc., order Amstrad part from PV Tubes £15·35 inc.

Anyone who had an account with Mastercare will remember that about two years ago the accounts were transferred to HRS Ltd., who are fine but don't supply Saisho or Triumph parts. So before we all crib about other engineers, let's look at manufacturers and suppliers.

Lastly, on contacting ITT's technical department, which used to be very good, we were told that they cannot help unless we have an account. But you try and get one.

On the plus side, congratulations to Sanyo/Fisher's spares and technical department for good prices and service.

R. Lewis, Proprietor, Technical Services,
Aylesbury, Bucks.

EXPENSIVE SCAN COILS

I'd like to comment on the cost of spares from Mastercare Components – spares for Dixons and Currys own labelled goods, e.g. Saisho, Matsui, Triumph etc., appear to be available only from this source. We recently had a dead 14-month old Matsui 14in. CTV in for repair. After replacing the STR451, zener diode etc. we found that the scan coils were faulty, so a quote was requested from Mastercare. It arrived some weeks later: £10 for a circuit photocopy and, wait for it, £90·64 for the scan coils! How are we to carry out a viable repair on this quite new £150 TV set?

I suggest that all independent servicing personnel should draw public attention to what an out-of-guarantee breakdown of a Currys or Dixons set is likely to mean.

S. O'Haglan, City Television Services,
Plymouth, Devon.

CONSUMER ELECTRONICS: WHAT NEXT?

The fall in the price of new VCRs over the past couple of years is a clear indication that market saturation is approaching. DAT (digital audio tape) was seen as a way of maintaining the growth impetus of the consumer electronics industry but has been priced above what the public, even in Japan, is prepared to pay. So what, in the short term, could the industry produce that will sell in millions to domestic consumers?

One possibility has been opened out by the liberalisation of the public telephone services around the world. The telephone itself has many disadvantages. Apart from the expense, you often receive calls when you don't want them, and when you try to make a call the person you want is all too often not available. In addition, what is said is easily disputed or simply forgotten. Letters on the other hand take too long. If a transaction requires a lot of questions and answers a telephone call is theoretically cheaper and quicker – provided both parties are concise, available at the same instant, and have to hand any information that may be required. In practice this is seldom the case.

A system exists that combines the advantages of the telephone and letter. It's quite widely used by businesses and is called fax. A single A4 sheet can be sent for the price of a 5p call in half a minute or so, making it far cheaper than a letter. It doesn't require the use of a keyboard, which might put many people off. Messages can be written on ordinary paper and fed into the machine. An urgent reply can be received a short while later – without the intrusion of a ringing telephone bell.

At the present time telephone/fax installations cost around £1,500. If the industry could apply production engineering technology to cut the cost to around £500 fax could become a consumer item. As the price fell from the present £1,500, smaller and smaller businesses would buy them. Eventually private individuals would use them to contact businesses and then each other.

The interesting point is that the basis of a photocopier, laser printer and fax machine is very similar. A laser printer can be used to produce bit image graphics from video sources, i.e. large plain paper photographs from video cameras. Thus mass production of this printing mechanism could be applied to all these products. Though originally a business machine, photocopiers have been sold to individuals for some time, and it won't be long before laser printers are sold to home computer users.

A cheap, combined fax/telephone seems to be a useful and worthwhile product to offer the public and would require no new technological breakthrough. In comparison, the extremely expensive small improvement in sound quality offered by DAT looks doomed to failure, like eight-track cartridges.

John de Rivaz, B.Sc. (Eng.),
Truro, Cornwall.

TEST CARDS AND CAPTIONS

I'm currently researching for *Television* an article on the subject of BBC test cards and captions – as a follow up to articles that appeared in the May 1978 and January 1984 issues – and would be very pleased to hear from anyone with reasonably good photographs of BBC test cards and clock captions/symbols, particularly unusual ones such as those occasionally transmitted at Christmas. Perhaps some readers might have old discarded reel-to-reel video recordings that could be transferred to VHS or Beta?

I would also be extremely interested to hear from anyone who might have recordings of the BBC Test Card C music from the late fifties and early sixties. Any information regarding early BBC trade test transmissions would be very much appreciated.

Keith Hamer, 7 Epping Close,
Derby DE3 4HR. Telephone 0332 513 399.

TV Fault Finding

Reports from Eugene Trundle, Nick Beer, Roger Burchett, Philip Blundell, Eng. Tech., Christopher Holland and Alfred Damp

Sony KV2022

From time to time while being soak tested a "twizzling" sound came from within this set, accompanied by slight line tearing – the verticals in the picture became jagged and ill-defined. We had no doubt that this was due to failure of either C609 or C621 in the power supply since we've had trouble with these capacitors on previous occasions, but replacing them had no effect on the admittedly very intermittent symptom. It took us some time to trace the fault to the low-value sampling resistor R637. It was making mischief on the h.t. rail directly, not via the ECL (excess current limiting) circuit of which it forms a part. **E.T.**

Sanyo 83P-D20 Chassis

This chassis is used in several Sanyo sets, including Models CTP6133 and CTP6135. The complaint with one set that came in for service was that the colour varied. The effect was very subtle, with slight saturation changes being visible on the colour-bar pattern. Small amplitude variations could be discerned at the colour-difference outputs from the μPC1403A colour decoder chip – at pins 11, 12 and 13. There's a phase (tint) adjustment input at pin 19 of this chip, and with close scrutiny of the screen of a scope connected to this point we could see that some noise was present. The trouble was due to a "grumbling" decoupler, C283, whose leakage current varied constantly when checked out-of-circuit with an ohmmeter. **E.T.**

Salora J Chassis

The complaint was that the set would go to standby as soon as the picture appeared. A field engineer had tried disconnecting the tripler and the IR receiver module in case the latter had become noisy, sending random standby, channel change etc. signals to the remote control section. He'd also tried unplugging the teletext panel to eliminate that – it's quite a common cause of trouble. I found that by pushing the on/off switch right in (overriding the momentary contact) the set would run merrily, but you couldn't change channels either via the remote or the on-board controls. A handy feature of these sets is the switch at the back above the aerial socket. If you turn this the standby mode is overridden. By doing this I could check voltages and soon found that the SAA1251 chip (ICC9) was faulty.

Any height and/or width twitching with these sets can usually be cured by replacing the LF0041 Ipsalo circuit control chip – it's a hybrid i.c., circuit reference HB1.

It looked as if the static convergence was out on one of these sets – the reds were miles out, and of course there are no adjustments. So the only answer was a new c.r.t. plus yoke. Surprisingly the emission was good – these tubes (A51-590X) tend to go down prematurely. **N.B.**

Sanyo CTP5103

There was a nasty looking fault on this ageing set. On very high contrast scenes the picture would intermittently roll uncontrollably. I was not in a very good mood for thinking about this but set about checking the a.g.c. and video circuits, then turned to the sync circuitry. This is quite complex: there's a sync amplifier and driver stage in addition to the sync separator. D201 in the sync driver stage caught my eye as a likely suspect and turned out to be very leaky. Replacement provided a cure, though a long soak test was required to be sure. **N.B.**

Thorn 1615 Chassis

The line frequency was miles off. It could be adjusted by altering the setting of the line oscillator coil but the picture wouldn't lock. The cause of the trouble was the 1S44 flywheel line sync discriminator diodes: W25 had a 400Ω leak each way and W26 was open-circuit. **N.B.**

Sony KV21XRTU

A number of these sets seem to have the same fault when unboxed – a rope pattern about ⅛in. wide one third of the way across the screen from the left-hand side. In each case the pattern has been more noticeable on BBC-1 (ch. 55). Having had similar troubles with earlier Sony sets I check that all leads are dressed correctly and for dry-joints on heavy legged components in the line timebase and power supply areas. In most cases the suspect joints have been around C715 and the scan coil connection plug. **N.B.**

Thorn 1615 Chassis

"Picture up from the bottom and down from the top" was the fault description with this set. It was true, but was due to the fact that there was excessive width – it would have filled two 24in. tubes! After first diving for the line output transformer harmonic tuning capacitors, which have given similar symptoms in the past, the cause of the trouble was found to be the scan-correction capacitor C136 (0·15μF, 250V). A bulge could be felt in its side. **N.B.**

Sony KV1412

This set simply wouldn't start. Having had a similar occurrence previously I condemned IC601 (μPC1394C), but a replacement made no difference. Being a B.F. I hadn't checked the start-up supply resistor R602 (2·2MΩ) which was open-circuit. **N.B.**

Thorn 1615 Chassis

The line linearity coil in this chassis is prone to dry-joints, no doubt due to the fact that it's mounted on a vertical panel with no support other than its lead-out pins. A call to attend to a "vertical white line" is thus common. Fortunately the damage to the panel is usually only slight. **R.B.**

Rank T20 Series Chassis

I was recently called to a T22 whose tripler had melted very badly. Luckily the owner had been alerted to the trouble and had switched off. But why hadn't the set tripped? Because the tripler was a "universal" replacement type and whoever had fitted it hadn't checked the associated 330Ω resistor 5R13 which was open-circuit.

This is the current-sensing resistor, so the trip wasn't operational. The moral is simple: check 5R13 after replacing the tripler or dealing with any fault that has resulted in heavy overloading in the line output stage. **R.B.**

Fidelity ZX3000 Chassis

The problem was sound distortion after the set had been on for a few minutes. The speaker was very poor – it had a "soggy" cone with a rip in it – but the TDA8190 sound output chip was the real culprit. **R.B.**

Alba CTV10

This Hong Kong made colour portable wouldn't start up. Apparently it had been repaired recently by an engineer who had moved on. There are two start-up resistors in parallel, R301 and R302, both 330kΩ, 0·5W. These had been replaced with a single 0·5W resistor mounted very casually on the print side of the board – no sleeving on leads almost bridging tracks. Replacing R301/2 with resistors having the correct values and wattage ratings restored the set to health. **R.B.**

Ferguson TX9 Chassis

The cause of an overbright raster was found to be the fact that R235 (1MΩ) was virtually open-circuit. It links the earthy side of the tube's first anode supply potentiometer to chassis. Some sort of spillage seemed to have been responsible for the trouble. **R.B.**

Philips KT3 Chassis

Why are faults on friends' TV sets always awkward? The cause of anyone else's dead KT3 would have been a dud 4·7Ω surge limiter resistor or tripler, but oh no!, not this time. The power supply was providing no h.t. output though there was 12V at the chopper control chip and 300V or so at the chopper transistor. There was no overload information at the chip, so a replacement was fitted. The power supply then started, but constantly tripped – due to the tripler. Had it arced over as it died? We will never know. **P.B.**

Sanyo CTP6143/4

Here's a tip from the latest issue of Sanyo's Technical Bulletin. In the event of thin horizontal bars on channels above 41 on Models CTP6143/4, add an 0·47μF, 50V Mylar capacitor across C123. the latest issue of the Bulletin makes very interesting reading: there are circuit descriptions of the picture-in-picture facility and digital servos, and a list of some useful common faults. **P.B.**

Rank T24 Chassis

No colour with these sets is often due to failure of R229 (3·6kΩ) on the main panel. It's a pulse feed resistor and tends to go open-circuit. **P.B.**

ITT 80-110° Chassis – Panel CVC825

There was intermittent loss of the raster, with line collapse as it went off. The power supply was shutting down, removing the line drive (which comes from the chopper transformer in this chassis). The fault usually occurred about ten minutes after switching on: the set would then start again and run for hours without further trouble. Past culprits (D611, R628, R632 and R643) were checked by substitution but were blameless. Then one day the set stayed off for longer than usual, enabling the culprit to be found. The BC546A chopper drive transistor T615 was breaking down. **P.B.**

ITT CVC801 Chassis

For intermittent failure of the power supply to start (early models only) remove R774 (100kΩ). For no or low 110V line check the capacitance of C757 (10μF). For no e.h.t. with the 110V and 20V lines present check for dry-joints at R700 and L700. **P.B.**

Contec KT8135 and KT5145

For a dead KT8135 with all the fuses intact check whether R501 or R502 (both 330kΩ) is open-circuit. With the KT5145 the resistor to check is R504 (again 330kΩ). **P.B.**

Hitachi NP81 Chassis

This set, passed on to me by another dealer, had the classic symptoms of lack of line and field sync pulses. My colleague had spent some time on the set and, in his usual thorough fashion, had started by replacing the relevant chip – IC701, type LA7801 – which incorporates both timebase generators as well as the sync separator circuit. He'd then replaced every capacitor within a three inch radius of the chip before deciding to call it a day. This groundwork made it easy for me. If it wasn't the chip and it wasn't the capacitors, it had to be a resistor. Sure enough R723 (22kΩ) was open-circuit. **C.H.**

ITT TX2612 (CVC1215 Chassis)

This teletext set illustrated how easy it is to jump to premature conclusions. Fuse Fu651 was open-circuit and a quick in-circuit check showed that the BU508A chopper transistor appeared to be short-circuit collector to emitter. After replacing the transistor and fuse and switching on we were blinded by a flash as the fuse again failed. We removed the replacement chopper transistor and checked it out of circuit. It read perfectly. When we'd found the original transistor at the bottom of the rubbish bin and checked it we discovered that it too was perfect. The culprit turned out to be C701 (10μF, 350V). **C.H.**

Philips K40 Chassis

There were no results, the channel indicators permanently displaying 88 while a lot of hissing came from the e.h.t. cap. The first thing to do was to clean the final anode connection and replace the cap to prevent further damage to the set. Checks were then carried out around the μCMSM8050 microcomputer chip IC7101. After replacing this the set worked – apart from no sound due to a high at pin 13 of the TBA120. This fault was traced to an internal fault in the HEF4052 chip IC7202 on the power/scart board. If the customer had had the e.h.t. cap cleaned when it first started arcing it would have saved a considerable repair bill.

We subsequently had to return to the set for "no results". The customer said "it's been hissing for a couple of days but we thought it would get better, then there was a big flash and the set went dead". Here we go again . . . **A.D.**

Teletopics

SATELLITE TV LATEST

The West German DB satellite TV-Sat 1 has been abandoned following the failure of the main receiving aerial to unfold. This problem was in addition to the one mentioned last month – failure of one of the solar panels to open out. While there was telemetry contact with the satellite, without the main receiving aerial there was no broadcasting uplink and thus no possibility of a broadcasting downlink. It appears that the French TDF-1 satellite, which is of the same type, manufactured by the Eurosatellite consortium, will not be put into orbit – at least until the cause of the problem has been resolved. A sad end to Europe's first attempt at DBS.

Meanwhile production of the two BSB (British Satellite Broadcasting) satellites for the UK DBS service is said to be ahead of schedule. The satellites are being produced by Hughes Aircraft in the USA, and a launch date for the first one has been booked for August 15th 1989 aboard a McDonnell Douglas rocket.

BSB has set up an international "competition" to find three approved suppliers of receivers for the UK DBS service – about fifty setmakers have been approached. This rather unusual arrangement is possible because BSB is to use a code to ensure that only receivers produced by approved suppliers will be able to decode the signals – in addition a pay-TV coding system is to be built in from the start, so that certain programmes will be viewable only after making an additional payment. After the first couple of years the system will be deregulated so that all receiver manufacturers can produce and supply sets. As BSB's managing director Graham Grist put it "then we'll let it rip". The aim of the initial restriction is to ensure that receivers for the service are made available in reasonable quantities at affordable prices. Each of the selected companies will be expected to produce around 100,000 receivers during the first year, at a price to viewers of about £200.

The BSB transmissions will be to the D-MAC standard. It seems that the medium-power Astra satellite, due up this autumn, will use the D2-MAC standard, as was to have been used by TV-Sat 1 and TDF-1.

The government is to contribute £2·5m towards a demonstration by the BBC and the IBA of the wide-screen, high-definition version of MAC (HD-MAC) at the International Broadcasting Convention in Brighton this September. The importance of this demonstration lies in the fact that a specially convened meeting of the CCIR (International Radio Consultative Committee) in Brussels next spring will be reviewing the question of international HDTV standards, prior to the next plenary session of the CCIR due in 1990.

The IBA has awarded the contract for D-MAC coding equipment for use with the BSB service to EB Telecom AS of Norway. The equipment will form part of the satellite up-link ground station for the service. To assist the receiver manufacturing industry there will be terrestrial test transmissions of the D-MAC signal from July, with possibly satellite test transmissions soon afterwards. Delivery of the main equipment for the up-link ground station is targetted for the spring of 1989.

NEC has introduced a new, improved range of TVRO equipment for use with the currently operating TV satellites. In addition, trade prices have been reduced. The new feed systems used with the dishes, which are available in 1·5m and 1·8m sizes, have increased the gain (by 0·7dB with the 1·8m dish) and reduced the noise temperature by an equivalent to 0·5dB in the LNB. The LNB itself, which uses a custom made thin-film circuit, has an improved noise figure of 1·7dB average and 1·9dB typical maximum.

BROADCASTING NEWS

A technical committee set up by the Department of Trade and Industry has concluded that a fifth terrestrial u.h.f. TV network serving 60-70 per cent of the UK's population is feasible – in fact a sixth network serving 50 per cent of the population could also be introduced. The fifth channel network would mainly use two u.h.f. channels not at present allocated to TV, chs. 35 and 37: about 20 per cent of the population could be served simply by using spare capacity in the present 44 channels. About fifty new transmitters would be required. The problem of receiver local oscillator interference – the present blocks of channels are arranged to minimise this – could be overcome by the use of frequency offsets and reliance on the much improved selectivity of modern TV receivers. Many VCR owners would probably have to retune the output from their machines however, and an extra receiving aerial would generally be required. Provision of a fifth channel could be included in one of the two broadcasting bills the government intends to introduce in 1988/9. Such a network would be unlikely to come into operation before 1991/2.

The Rank Organisation has approached the government for permission to operate a pay-TV service along the lines of the French Canal Plus. Rank's transmitter network would use either the fifth or sixth channel networks mentioned above or unallocated capacity in the v.h.f. spectrum. The latter could provide a service for over 70 per cent of the population. The company has been having talks with the DTI technical committee on extra channels and would be prepared to invest £50-£100m in such a project. Programming would centre on new films, drama and sports and the company maintains that it could start a service in 1990. If it was provided at v.h.f. an upconverter/decoder costing "less than £100" would be required. Subscribers would pay £8-£12 a month and receive up to 60 films monthly. The company estimates the potential demand at up to three million subscribers.

On December 9th the IBA completed its £50m project to provide Channel 4/S4C coverage from its 867 transmitting sites. The final station to be equipped, Gunnislake in Cornwall, was brought into full operation on December 18th.

While the BBC maintains that there will be no terrestrial stereo TV sound service from its transmitters until 1991 at least, such a service could well be provided by the IBA in London from next year, then spreading to the rest of the country.

THE VHS SQ SYSTEM

Preliminary details of its proposed VHS SQ (Super Quality) system have been released by the French firm Thomson. The system has been designed to exploit the improved performance of Super VHS (S-VHS) tape, which is not yet available in PAL markets, while maintaining compatibility with the basic VHS system. The advantages of S-VHS over conventional VHS tape include greater h.f. output, a higher signal-to-noise ratio and a superior dynamic range. The VHS SQ system takes advantage of this by means of modifications to the record amplifiers. To eliminate cross-colour effects the machines will provide separate luminance and chroma feeds to the receiver. The standard 3·8-4·8MHz f.m. carrier deviation is preserved to maintain compatibility. Whether VHS SQ will be accepted as a variant within the VHS family of specifications remains to be seen. No launch dates for VHS SQ machines have been announced.

NOKIA'S TV INTERESTS GROW

The trend for European TV set manufacturing interests to be merged into ever larger groups has taken another significant step forward with Nokia of Finland's agreement to buy Standard Electrik Lorenz (SEL) from CGE-Alcatel of France. Nokia owns Salora and Luxor (both bought in 1983) and only recently acquired the French TV setmaker Oceanic. Both Oceanic and SEL of West Germany were previously ITT subsidiaries. SEL came to CGE-Alcatel when the CGE and European ITT telecommunications interests were merged earlier last year. SEL at present produces around 1·2 million TV sets, 1·7m colour tubes and 350,000 VCRs a year. The acquisition will boost Nokia's TV setmaking capacity to well over two million sets annually and give it a 14 per cent share of the west European market. Explaining the move, SEL's chairman Helmut Lohr commented that the division was too big to be a specialist producer and too small to be able to survive in the face of increased international competition. Without the merger SEL would have had to incur heavy redundancies – SEL has 5,600 employees. Following the take-over, consumer electronics goods will account for about 60 per cent of Nokia's annual sales.

MORE TV PLANTS IN UK

JVC is setting up a £27m plant to produce colour TV receivers at East Kilbride near Glasgow. The plant is expected to be in production by the middle of the year and will create 200 jobs initially. If successful, production of CD players and computer display monitors will be added.

South Korean consumer electronics manufacturer Goldstar, which recently opened its first European plant at Worms, near Frankfurt, plans to build a factory in the UK. South Wales or the North East have been suggested as likely sites for the plant, which will initially produce microwave ovens, with VCRs and small-screen CTV receivers added later. The factory might be operated as a joint venture – Goldstar has held talks with Fidelity. The Worms plant has a production capacity of 300,000 large-screen CTV receivers and 400,000 VCRs a year. Goldstar began selling in the UK under its own name last September: sales of its goods under other brand names have been running at around £36m a year.

Mitsumi Electric will shortly open an electronics components factory in South Tyneside, Tyne and Wear. Output will include modulators and tuners for VCRs and CTV receivers, and coils, transformers and power supplies for consumer electronics equipment generally.

DOMESTIC TV SECURITY SYSTEMS

Home security is a growing business – in the last six years consumer spending on security is estimated to have risen from £84m to £175m annually. Ferguson and Sony have both recently announced surveillance systems that enable the householder to see who is calling at the front door. Ferguson calls its systems Homescan while Sony's system is called WatchCam.

There are two Ferguson Homescan "access control" systems, both of which can be easily installed by a competent DIY person in a couple of hours. The cameras used in both systems have CCD image sensors and incorporate infra-red LEDs which illuminate the subject under view even in total darkness. Vertical resolution is 400 lines, assuring picture clarity, and the camera's field of view covers an area of about one metre width at a distance of only one metre. The Homescan FHS1 consists of a video camera, mounting plate, camera control unit and r.f. lead and has a suggested price of around £499. The camera's output, on a preset channel, is fed to a domestic TV set, giving one-way audio and visual communication. By wiring the FHS1 system through the doorbell circuit an audible alarm will interrupt the TV program being watched, so that the viewer can switch to the appropriate channel to observe and hear the caller. The FSH1 can also be used as an indoor baby minding etc. system. The FSH2 system, with a suggested price of £749, consists of a video camera mounted in a unit that includes a bell push, microphone and speaker, and a separate video monitor/control unit. Both items come with wall-mounting brackets. When the visitor has been identified an electric door lock can be released by pressing a button on the control unit: a LED indicator shows when the door is open or unlocked. Two cameras can be linked to the monitor/control unit, giving surveillance indoors and/or outside.

Sony's WatchCam system, with a suggested price of about £580, consists of a very compact camera (52 × 32 × 100mm) and an easily positioned monitor about the size of a cordless telephone. It can be used indoors or outdoors to check activity around the home. Optional accessories enable the camera to be connected to a VCR, giving surveillance while the occupier is out. The system comes with everything required for DIY installation. A microphone and loudspeaker are included to give audible surveillance.

PAL/SECAM TRANSCODING

We have been asked to point out that Universal Electronics of Paris, mentioned in the article on TV and VCR conversions last month, will not deal with the public direct. Their UK agents are North East Satellite Systems of Cropton, Pickering, North Yorkshire YO10 8HL (telephone 075 15 598). North East Satellite Systems can supply PAL/Secam and Secam/PAL transcoders and satellite equipment for the 2·5GHz, 4GHz, 11GHz and 12GHz bands. They have recently been appointed distributors for ADM dishes ranging from 16-32ft and for AVCOM (Virginia, USA) TVRO equipment including test gear and professional receivers.

IN BRIEF

Granada's bid for Electronic Rentals (Visionhire) is to go ahead following 85 per cent acceptance of the offer: there is to be no Monopolies Commission enquiry . . . Grundig has appointed companies to run four regional service centres – Craigavon TV Services in Northern Ireland, MP Electronic Services in Rugby, Clifton TV and Audio Services in Bristol and the Glasgow Service Centre. The aim is to have fifteen Grundig Service Centres by the end of 1988 . . . The Home Entertainment Dealer Show HEDS '88 will be held at the Birmingham National Exhibition Centre from May 8-10th.

Dual-channel TV Sound Systems

Part 2: Basic Digital Techniques

Geoff Lewis, B.A., M.Sc.

Modern hi-fi stereo sound systems use extensive digital signal processing. This month we'll look at some of the basic techniques involved, as an introduction to next month's concluding instalment which will describe systems either in use or to be brought into use shortly.

Advantages of Digital Processing

Analogue TV signal processing has remained dominant because of the need to conserve space in the frequency spectrum available. However there are now some very convincing reasons for making a change.Today's digital i.c.s are capable of operating at high speeds and are available at prices that make them more cost effective than their analogue equivalents. Digital processing is compatible with the digital switching techniques used for signal distribution both in studios and, increasingly, in receivers. Encryption/decryption i.c.s are now readily available to provide security of transmission if required. Improved transmission quality, even in noisy environments, is possible using digital signal regeneration and error detection/correction techniques. Digital control of a TV receiver enables it to become an integrated centre of a home information service. Clever bit rate reduction techniques are now available to provide significant bandwidth compression. All these advantages are to be had by using modern digital signal processing chips.

Sampling and Quantization

The sound signal picked up by the microphone is in analogue form of course. So before any digital processing can be undertaken the signal has to be converted to digital form. This is usually done by using a sampling process. Fig. 1 illustrates the idea. The amplitude of the analogue signal is measured (sampled) at very precise intervals of time. Only the integer (whole figure) value of the measured level is retained. These measured values are then converted into binary form, which makes them suitable for digital processing. After processing they can be converted back to analogue form to drive a loudspeaker or whatever.

In the example shown in Fig. 1 there are eight discrete integer values, 0 to 7. These can be represented by three binary digits ($8 = 2^3$). Nyquist's theory of sampling shows that, provided a complex analogue signal waveform is sampled at a rate that's at least twice that of the highest frequency component of that waveform, the original signal can be reconstituted from these samples without distortion. In the example shown in Fig. 1 it will be seen that any signal reconstructed from the values obtained by the sampling will be only an approximation of the original: the error is called quantization noise. It will be obvious from this example that this noise component can be reduced to a lower level simply by increasing the sampling rate and/or the number of levels used. The penalty for doing this is an increase in the bandwidth required.

The bandwidth of a digital signal of this type can be calculated from the formula $2 \times fs \times n$, where fs is the sampling frequency and n is the number of bits per sample.

This sampling process produces a frequency spectrum rather like that of amplitude modulation, except that the range of sidebands extends towards infinity in the manner shown in Fig. 2(a). The demodulator circuit used contains a low-pass filter with a cut-off frequency below fs to remove the harmonic components and leave only the original baseband.

If the sampling frequency is not high enough, or the filter's cut-off is not sufficiently sharp, the result will be interference from the first lower sideband. This effect is known as aliasing and is shown in Fig. 2(b).

Quantization noise is proportionately more significant at small signal amplitudes; in addition, large signals can swamp or mask the noise effects. This imbalance can be remedied by using non-linear quantization – Fig. 3 shows a non-linear quantization characteristic. The near-linear region has the effect of increasing the number of levels used to represent small signal amplitudes.

Quantizing AC Signals

The analogue-to-digital conversion method just described works well for signals, such as video ones, that have a large d.c. component. For audio signals, which have positive- and negative-going excursions, an alternative approach is needed. One possible method is the "offset binary" technique, which involves adding a constant value to all the sampled levels. This can produce problems however, particularly with audio mixers used to add signals from different sources – the sum can overflow or exceed the allowable peak value.

The most commonly adopted solution is to use the twos complement method of representing binary numbers. This works as follows. By convention a leading 0 indicates a positive number while a 1 indicates a negative value. The twos complement of a binary number is simply obtained by inverting each bit of the number then adding 1 to the result. The twos complement of 01010101 is thus 10101010 + 1 = 10101011. When an analogue signal is reconstituted from a twos complement number the excess 1 should be removed before inversion. In practice however failure to do this results in such a small error that the step is often left out.

Bit Error Rate

The analogue of signal-to-noise ratio in the digital field is the bit error rate (BER). This is the number of bits received in error over a noisy channel. There are two basic ways in which a digital signal can become degraded: first where there are noise spikes of amplitude greater than the pulse amplitude, and secondly when there are timing errors in the receiver's resampling clock rate. It's common for the receiver's clock to be synchronised in some way from the data stream. Clock synchronisation timing jitter and/or phase distortion of the pulse waveform add further to the BER.

With a digital signal signal-to-noise ratio can be considered in terms of energy/bit per watt of noise power. Energy per bit can be maximised by increasing either the

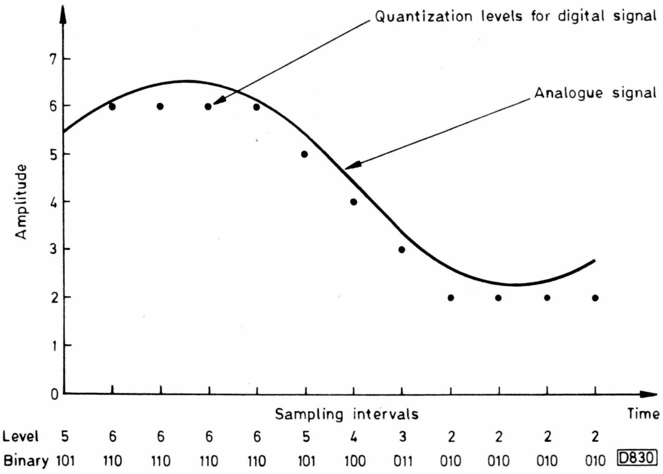


Fig. 1: Sampling and quantization.

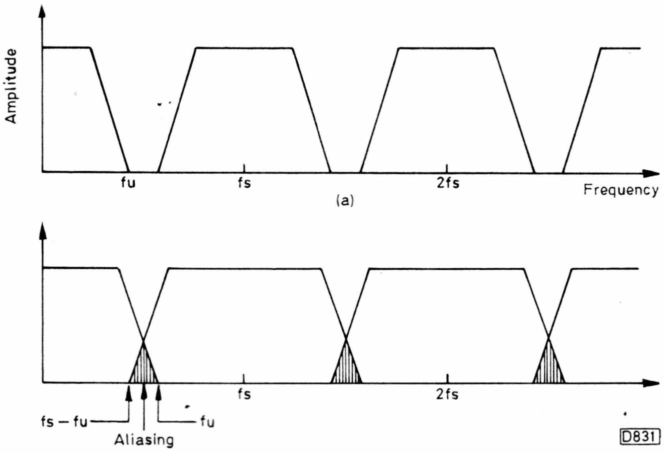


Fig. 2: Frequency spectrum for Nyquist sampling (a); introduction of aliasing (b).

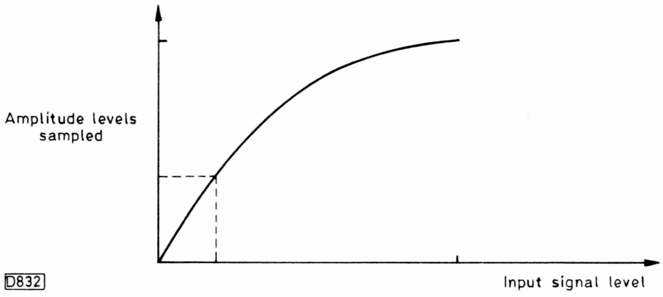


Fig. 3: Non-linear quantization characteristic.

pulse width or the pulse amplitude, the pulse width × amplitude product being a measure of the energy contained in a pulse. Obviously increasing the pulse width has the effect of reducing the signalling rate. Shannon's Law for the channel capacity required to transmit data shows that system bandwidth can be traded for signal-to-noise ratio to obtain a BER that's acceptable for the service concerned.

Baseband Codes

Binary code formats are designed to insert extra bits into the data stream in a predefined way. A few of the many ways of going about this are shown in Fig. 4. The aim is to minimise the number of consecutive similar bits in the data stream. The receiver clock can then be synchronised to a greater number of signal transitions, thus improving its timing. The fact that some of these formats have no d.c. component provides an extra advantage: the receiver's l.f. response requirement is reduced, allowing the use of a.c. coupled circuits.

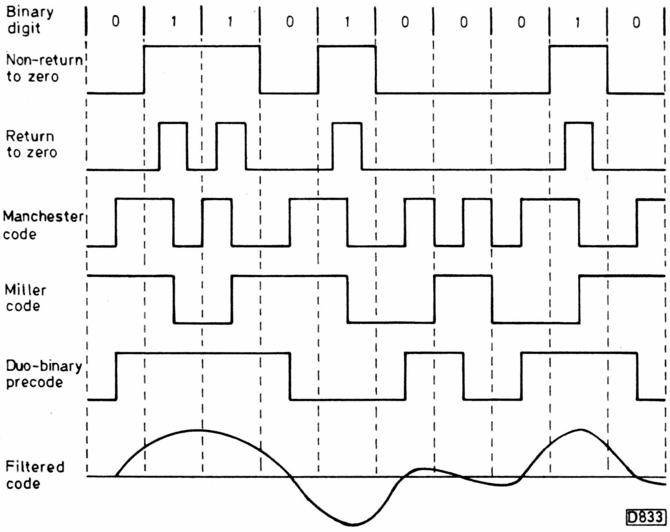


Fig. 4: Some binary code formats.

The commonly used codes can all be generated and decoded using appropriate i.c.s. They are generally based on the non-return to zero (NRZ) format — the return to zero (RTZ) format is little used because its half-width pulses represent an energy/bit penalty.

The basic Manchester code shown in Fig. 4 is one of the bi-phase series of formats which have the following features. A signal transition occurs at each bit cell centre, so that a zero is represented by 01 and a one by 10. This ensures that there are never more than two identical bits in succession. Another variant is the code mark inversion (CMI) format, where 0 = 01 and 1 = 00 or 11 alternately. Although there are 50 per cent redundant bits in bi-phase codes, and the transmission bandwidth required is doubled, there's no d.c. component in the power spectrum.

The Miller format is shown for comparison. It's favoured for use with magnetic storage systems. A one is represented by a transition at mid symbol and a zero by no transition — except when two consecutive zeros occur. In the latter case an extra transition is introduced at the end of the first zero.

The duo-binary code is a bi-polar, full pulse width code — one version is shown in Fig. 4. In general zero is represented by zero volts and one by +V and –V alternately, except when a succession of similar bits occurs. Code violations are then introduced in a controlled manner. In the example shown the NRZ code is first precoded as follows: a zero is represented by a transition at bit cell centre and a one by no transition. The precoded signal is then passed through a low-pass filter with a cut-off at the half-Nyquist frequency. Alternate transitions tend to average out to zero volts while a series of ones or zeros produces positive and negative peaks respectively. The major advantages of this system are that the bandwidth is only half that of other formats, there's no d.c. component, and the original data stream can be recovered simply by full-wave rectification of the received signal.

Redundancy Trade-off

The more efficient codes have the least redundancy: in

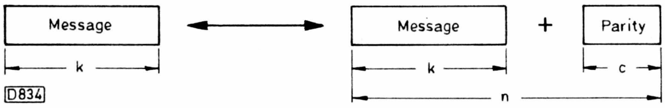
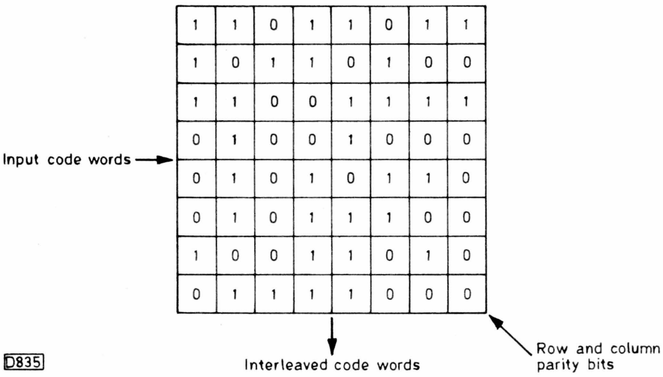


Fig. 5: Structure of a block code with error control.



1	1	0	1	1	0	1	1
1	0	1	1	0	1	0	0
1	1	0	0	1	1	1	1
0	1	0	0	1	0	0	0
0	1	0	1	0	1	1	0
0	1	0	1	1	1	0	0
1	0	0	1	1	0	1	0
0	1	1	1	1	0	0	0

Fig. 6: Interleaved code words.

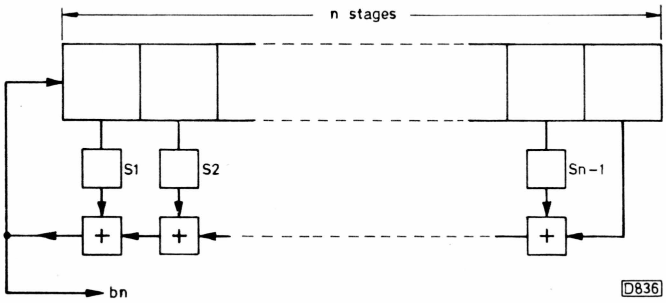


Fig. 7: Pseudo random binary sequence generator.

general there's a trade off between the code complexity required to balance the number of consecutive similar bits and the amount of added redundancy.

Error Correction

Provided that errors in a data stream can be detected, there are various corrective techniques that can be applied. One of the error concealment techniques could be used for example. The possibilitites here include: (1) ignore the error and treat it as a zero-level signal; (2) repeat the last known correct value; (3) interpolate between two known correct values. This last method is really suitable only when there is a significant amount of storage available in the receiver to allow time for the required signal processing.

The ASCII (American Standard Code for Information Interchange) code is commonly used to represent alphanumerical characters in a digital system. This 7-bit code provides for 128 different alphabetical, numerical and control characters. The commonly used word length is 8 bits (one byte), so space is abailable for one extra redundant bit.

A single error detection code can be produced by placing the first n-1 bits of information in the first positions and making the nth bit (the "parity bit") a 0 or a 1 so that the complete code pattern contains an even number of ones. This is referred to as even parity. If such a code is received over a noisy channel and is found to contain an odd number of ones we know that an error has occurred. With "odd parity" the nth bit is such that all valid code words contain an odd number of ones. In either case a receiver check will show when errors have occurred. The parity bits can be generated and checked using exclusive-or and exclusive-nor logic respectively. Such an arrangement of bits is known as an n,k code, i.e. n bits long and containing k bits of information. It follows that n − k = c, the number of parity bits. The structure of such a code pattern is shown in Fig. 5. The set of 2^k possible code words is often described as a "block code".

Table 1: Processing a 7,4 block code

Bit position	1	2	3	4	5	6	7
Parity/message	P	P	M	P	M	M	M
Check one	★		★		★		★
Check Two		★	★			★	★
Check Three				★	★	★	★
Message			0		0	1	1
Parity bits	1	0		0			
Transmitted word	1	0	0	0	0	1	1
Received word	1	0	0	0	0	0	1
Parity recheck	0	1		1			

Syndrome = 110 (reverse order) = 6, i.e. bit 6 is in error. Invert 0 and the error is corrected.

Hamming Codes

R. W. Hamming, the originator of most of the early work on error control in digital systems, devised methods that in addition to detecting errors in the bit stream can identify which bits are in error. These can then be corrected simply by inversion. The system works by interleaving the message bits with a series of parity bits. Assuming a 7-bit pattern, parity bits are placed in positions 2^0 (1), 2^1 (2) and 2^2 (4) with the message bits in the remaining positions as shown in Table 1, which also shows the mechanics of processing a 7,4 block code. The message bits to be transmitted are in positions 3, 5, 6 and 7. Three parity checks are carried out to calculate the bit values required in positions 1, 2 and 4. Arithmetically, the parity bits are found by adding the ones in the positions indicated, dividing by two and using the remainder for the even parity bit.

On receipt of the code word the parity is again checked as shown. This results in a bit pattern known as the "syndrome". When taken in reverse order this gives the number of the bit in error. An all correct transmission yields an all-zero syndrome.

This single-error correcting 7-bit code can be extended to give double-error detection by adding an extra overall parity bit check in the eighth position. The error patterns are then indicated by the following rules: (1) No errors — zero syndrome and overall parity correct; (2) single correctable error — non-zero syndrome and overall parity fails; (3) double non-correctable errors — non-zero syndrome and overall parity correct.

Cyclic Codes

In practical conditions the channel noise added to a signal can give rise to errors that occur in bursts. A subclass of block codes has been devised to combat this problem — the so-called "cyclic codes". The format is as follows. If a code word say 0110 is valid then so are all the cyclic transpositions such as 1100, 1001, 0011 obtained by shifting the binary sequence one bit at a time to the left or right. These codes can be easily generated or decoded using i.c.s that incorporate feedback shift registers. Since not all the possible combinations of bits in the list of valid code words are permitted, errors tend to generate bit patterns that are non-valid and thus obviously erroneous. Cyclic redundancy checking (CRC) is an extension of parity checking, allowing bursts of errors to be detected and corrected in addition to dealing with random errors, which are effectively burst errors of length 1.

Golay codes are an important sub-set of the cyclic codes. The 23,12 version with 11 parity bits is capable of correcting any combination of three random errors, including a burst of three, in a block of 23 bits. Encoding and decoding can be accomplished using i.c.s that make the process transparent to the user.

BCH and Reed-Solomon codes are further sub-sets of the cyclic codes, developed to provide greater efficiency in terms of fewer parity bits required for the same degree of correctability. Again processing can be through i.c.s that make the operation transparent.

Interleaved Codes

The use of interleaved or interlaced codes is a simple but powerful way of dealing with both random and burst errors. Any n,k set of code words can be converted into a new code xn,xk by loading the code words into a matrix of n columns and x rows and then transmitting the bits column by column. Fig. 6 shows the principle. If, over a noisy channel, bursts of errors less than x occur there is only a maximum of one bit in error in any one word. As a lower limit, if the original code corrects t or fewer errors the interleaved code will correct any combination of t bursts of length x or less.

An extension of interleaving is sometimes used. This involves the generation of two Reed-Solomon codes from the data, then cross-leaving the coded bit patterns before transmission. Provided the encoder and decoder are synchronised, relatively long burst errors become correctable.

Pseudo Random Binary Sequences

For a series of binary digits to be in random order each symbol must occur by chance and not be dependent upon any previous symbol: over a long period the number of ones and zeros should be the same. Similarly, runs of two, three or more of each symbol should be equally probable. Sequences with similar characterisitcs can be generated using shift-registers in the manner shown in Fig. 7, where the logic states of the switches control the feedback paths through exclusive-or gates, the state of the switches Sl to Sn − 1 being set by an initialisation word.

Assuming, for simplicity, a 3-bit register (in practice the pseudo random binary sequence — PRBS — register will be much longer), with only Sl set to 1 the sequence shown in Table 2 will be produced and will be repetitive. There are 2^n possible shift register states, but the all zero combination is invalid as this would halt the generator.

Table 2: Simple PRBS sequence

State	b1	b2	b3	bn
1	1	1	1	0
2	0	1	1	1
3	1	0	1	0
4	0	1	0	0
5	0	0	1	1
6	1	0	0	1
7	1	1	0	1

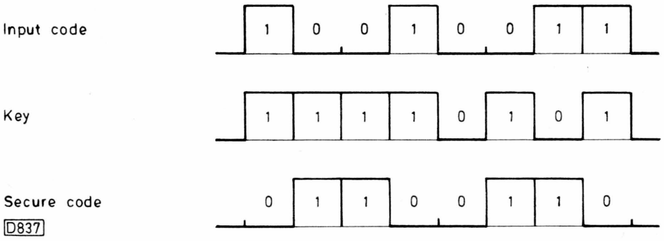


Fig. 8: A simple encryption system.

There are thus 2^{n-1} bits in the sequence bn. Because of the pseudo random properties of these sequences they can by used as: (1) repeatable noise sources for testing digital systems; (2) a means of adding redundancy to a transmitted data stream, by coding the sequence as logic 1 and its inverse as logic 0; (3) to provide a key to ensure data security when added to a data stream via an exclusive-or gate, as indicated in Fig. 8.

Scrambling and Encryption

The terms scrambling and encryption tend to be used synonymously. We'll use the word scrambling to mean the rearrangement of the order of the original information and encryption to indicate that the original information, consisting of "plain" or "clear" text, has been replaced by some alternative code pattern known as the "cipher" or "encrypted" text. Scrambling alone is not considered to be secure — a study of the signal behaviour can usually lead to the design of a suitable descrambler.

Encryption is quite simple, particularly when the signal is in binary electronic form. The addition of a second binary sequence to the first via exclusive-or logic produces another sequence that carries no obvious information. The original code pattern can be recovered at the receiver simply by carrying out a complementary operation. The rules of addition (and subtraction) using exclusive-or logic can be stated as: 0 + 0 = 0; 0 + 1 = 1; 1 + 0 = 1; 1 + 1 = 0 (the carry is ignored). The following is an example of encryption:

Code word to be transmitted:	10001110
Key:	10101010
Sum (exclusive-or):	00100100 — as transmitted
Key:	10101010 — at receiver
Sum (exclusive-or):	10001110 — original code.

The keys are generally produced using PRBS generators. These keys have several advantages — they are practically random and easy to generate and change, and the longer the key the more difficult it is to obtain unauthorised access.

The one-key system just described has a significant disadvantage however: the key has to be transmitted before the message. This results in a time delay and, perhaps more importantly, there's a risk that the key might full into the wrong hands.

Multi-key Systems

In a two-key system one key is made public for encryption whilst the second is kept secret and is used as a "modifier". This is also known as the Public Key system.

A very high degree of security can be provided with the three-key system. Two secret keys, primary and secondary, are user programmable and are stored in a digital

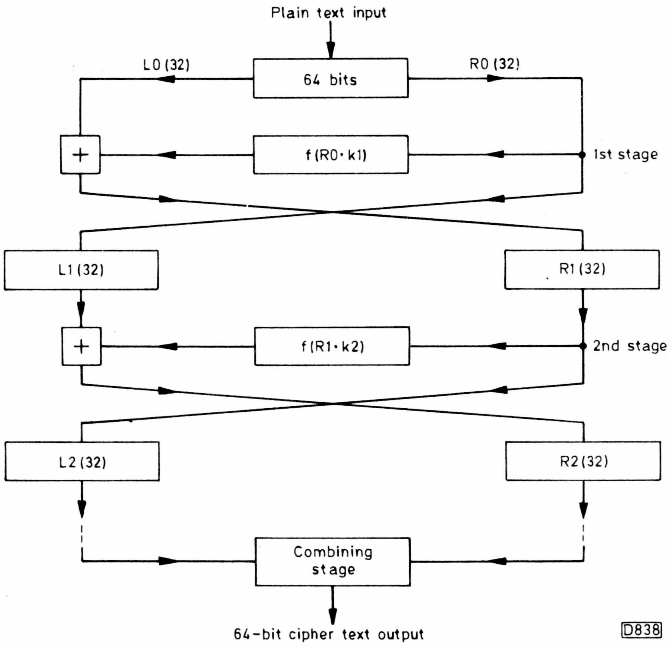

Plain text input
L0 (32)
64 bits
R0 (32)
+
f (R0·k1)
1st stage
L1 (32)
R1 (32)
+
f (R1·k2)
2nd stage
L2 (32)
R2 (32)
Combining stage
64-bit cipher text output
D838

Fig. 9: DES encryption algorithm.

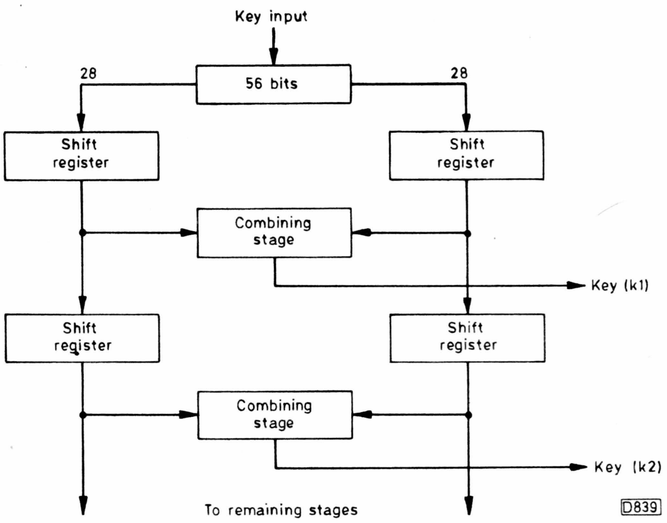

Key input
28
56 bits
28
Shift register
Shift register
Combining stage
Key (k1)
Shift register
Shift register
Combining stage
Key (k2)
To remaining stages
D839

Fig. 10: Key generator.

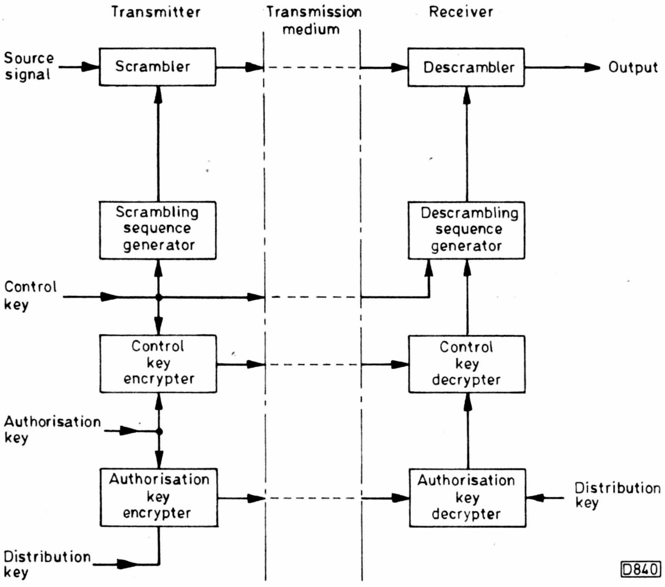

Transmitter
Transmission medium
Receiver
Source signal
Scrambler
Descrambler
Output
Scrambling sequence generator
Descrambling sequence generator
Control key
Control key encrypter
Control key decrypter
Authorisation key
Authorisation key encrypter
Authorisation key decrypter
Distribution key
Distribution key
D840

Fig. 11: Controlled access system.

memory. The third, non-secret key acts as a modifier: it can be generated as a new PRBS at the start of each transmission.

The DES Algorithm

The two most commonly used encryption algorithms are the RSA Public Key Exchange system (named after its authors Rivest, Shamir and Adleman) and the Federal Information Processing Data Encryption Standard (FIPDES).

The important rules of any encryption system can be stated as follows: (1) The number of possible keys should be very large to prevent a pirate from testing all possible keys in succession. (2) Any fixed encryption operation should be very complex, making it impossible to deduce the operation from a few plain text/cipher text pairs. (3) If security is to be based on secret information it must be created after the system is built and, if subsequently revealed, it should not jeopardise the entire system security.

The DES algorithm translates blocks of 64-bit plain text into similar blocks of cipher text using 56-bit keys. Each plain text block is divided into left (L) and right (R) groups, each of 32 bits, which are then processed as shown in the flow chart in Fig. 9. Successive R groups are combined with successive keys using a very complex function f. Each processed R group is then added via exclusive-or logic to the corresponding L group. After processing using 16 keys the L and R groups are recombined, but in the reverse order (R, L).

The 56-bit keys are produced by the hardware shown in Fig. 10. The initial group is divided into two 28-bit sub-groups for processing through a series of shift registers. A new key is formed by combining the sub-groups after one or two left shifts. The circuit resets after producing 16 keys.

It's interesting to calculate the probability of a pirate deciphering such a 56-bit key. This is one in 2^{56} or about one in 7.206×10^{16}. If our pirate made one attempt every nanosecond, on average it would take him more than 1.14 years. Cheaper to buy the key than rent the necessary computer time?

By using the DES algorithm repeatedly in overlapping blocks it's possible to encipher plain text blocks that are very much longer than 64 bits.

Controlled Access

Fig. 11 shows the basis of a controlled access system. It uses an extension of the DES 3-key algorithm. A PRBS is defined by a control key: this is for free access where necessary and may be made public. When restricted access is required this key can be encrypted by an authorisation key which is itself encrypted by a distribution key. Decryption of the authorisation key at the receiver is effected by the use of the distribution key, which may be transmitted over the channel or provided via a smart card. The encrypted version of the control key is decrypted by using the combination of authorisation and distribution keys: this allows the selection of the correct PRBS to decrypt the signal.

Bit Rate Reduction Techniques

The European PCM telephony system is an example of good spectrum management. Each 3.4kHz baseband audio channel is sampled at 8kHz and uses eight bits per sample, seven bits representing the signal level plus one for polarity. The basic bit rate per channel is thus 8 × 8kHz = 64kb/sec. Wider bandwidth signals can be accommodated by allocating a number of contiguous channels to the service. In order to conserve bandwidth quaternary or quadrature phase shift keying (QPSK) is used. Unlike bi-phase PSK, where each phase inversion represents an information bit, QPSK uses four phase shifts as follows: 0° = 00; 90° = 01; 180° = 11; 270° = 10. Thus each phase represents two information bits, doubling the information rate without increasing the bandwidth required. Relative to bi-phase PSK however the separation between code symbols is halved, leading to a 3dB signal-to-noise ratio penalty. Companding is used to combat this.

Bit errors can cause a problem when PCM is used for wider bandwidth signals such as music or video. The effect of a single bit error depends on its weighting. An error in the least significant bit (LSB) would probably pass unnoticed while a most significant bit (MSB) error would have considerable nuisance value. Using companded PCM with a music channel can cause the noise level to vary audibly as the signal level changes.

Delta and Differential Modulation

With delta and differential modulation (DM and DPCM) each audio sample is coded by just one bit, positive or negative, depending on whether the sample is greater or less than the previous value. Because only one bit per sample is transmitted during each sampling period the rate of sampling can be increased quite significantly. This reduces quantization noise and the bandwidth required, and simplifies the receiver's anti-aliasing filter.

The principle is illustrated in Fig. 12, which also shows the effect of a one-bit error. The general waveshape is maintained despite the error. An overload effect can occur when the signal changes by a greater amount than the quantizing step size, but since this mainly affects large-amplitude, high-frequency signal components, which occur only infrequently with audio signals, it's not particularly troublesome.

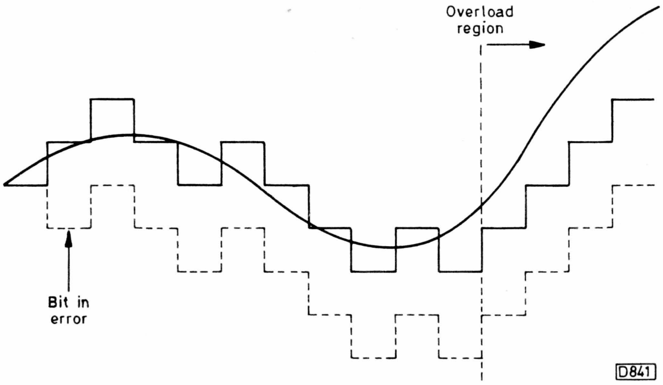


Fig. 12: Differential pulse-code modulation (PCM) signal, showing bit error and overloading.

Better results can be obtained with both DM and DPCM if the size of the quantization steps is made to vary in sympathy with the time-varying amplitude of the input signal. Adaptive circuits that provide this feature result in a significant improvement in quality. They behave as companded systems. To improve the signal-to-noise ratio further, pre-emphasis and de-emphasis can be employed in the analogue signal circuitry.

Sub-Nyquist Sampling

Alternate sampled values can be suppressed so that the sampling frequency is effectively halved. The missing samples are replaced at the receiver by using a process of interpolation or predictive coding. The overall effect is to reduce the bandwidth required by a factor of two. This technique requires the use of very stable, synchronised sampling clocks, accurate filtering and additional circuitry for interpolation.

The Fidelity ZX5000 Chassis

J. LeJeune

The trend in TV chassis design is towards increasing use of digital technology. We saw this first with remote control and teletext. More recently a set of ITT chips has enabled audio, luminance and chrominance signal processing, synchronisation and timebase waveform generation to be carried out digitally. Some of these chips form the basis of Fidelity's ZX5000 digital TV chassis. We refer to it as a digital chassis but it must be remembered that a lot of analogue circuitry is still required – in the tuner/i.f. section of the receiver and in the RGB and timebase output stages. In addition the audio signal remains in analogue form in the ZX5000 chassis.

The first model to use the ZX5000 chassis is the C20T04, which includes a teletext decoder with eight-page memory and on-screen control display. Intended to sell for around £300 this set is certainly competitive – the ITT Digivision range starts at around £500. ITT's top-of-the-range Model MC3896, which includes picture-in-picture, has a suggested price of around £870.

The advantage of going digital at the present time is debatable. Technical progress is always welcome however and the Digivision system does represent a radical step in TV chassis design. A simplified block diagram of the ZX5000 chassis is shown in Fig. 1.

Tuner and IF Section

A type U744 u.h.f. tuner is used in sets intended for the UK market. The output from this is fed to a fairly conventional i.f. section which consists of a screened module – it can be changed to suit different transmission standards. There is one preset accessible at the top of the module, to set the tuner a.g.c. Fig. 3 shows a simplified block diagram of this part of the chassis. The i.f. module has external audio input and output connections which are linked to pins 6 and 3 respectively of the scart socket. Pin 19 of this connector receives a composite video output signal from the i.f. module via the emitter-follower transistor TR6. Selection of composite video or RGB inputs via the scart socket, or r.f. from a VCR via the tuner, is done by selecting programmes 28, 29 or 30. The modular i.f. design facilitates production of receivers for

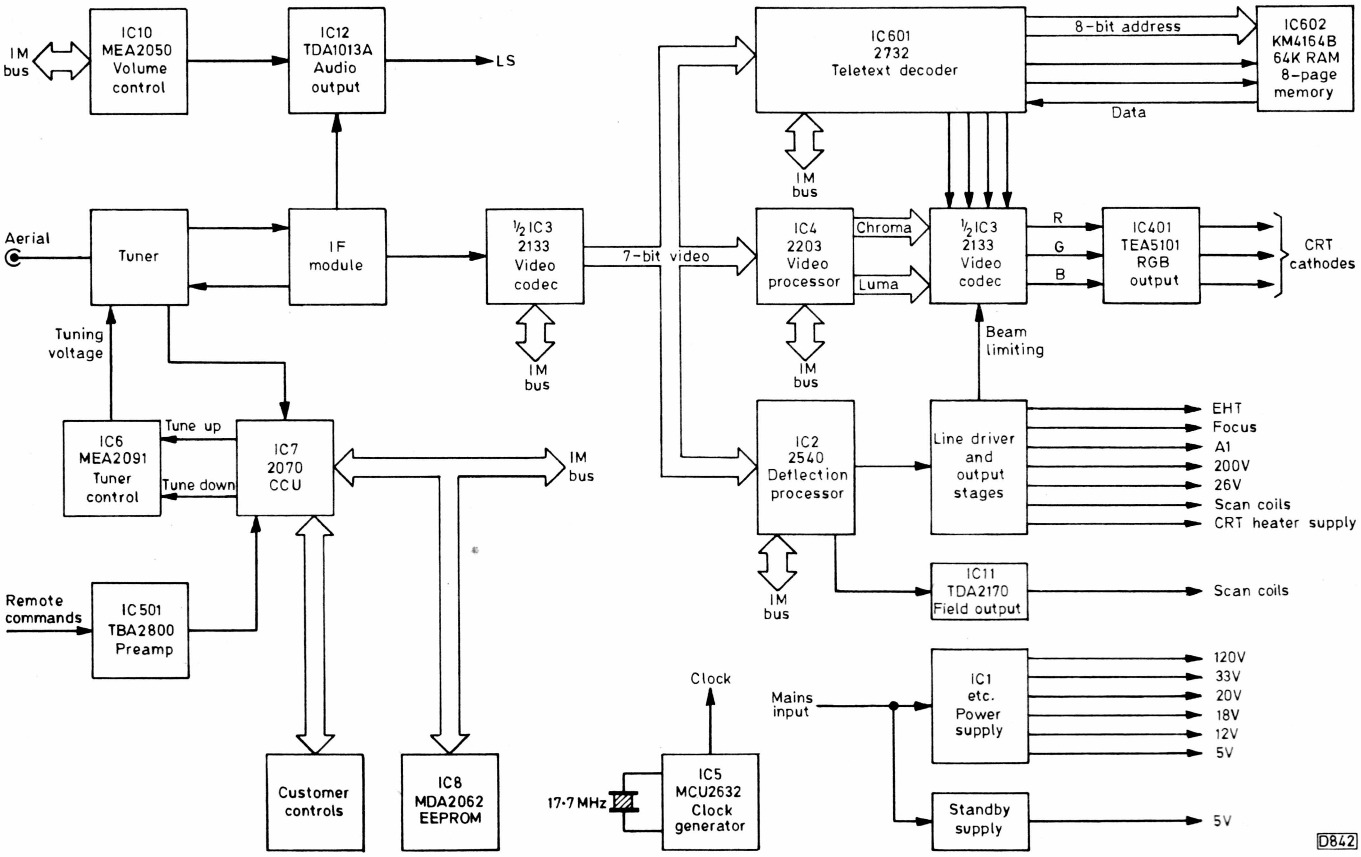

IM bus
IC10 MEA2050 Volume control
IC12 TDA1013A Audio output
LS
IC601 2732 Teletext decoder
8-bit address
IC602 KM4164B 64K RAM 8-page memory
Data
IM bus
Aerial
Tuner
IF module
½IC3 2133 Video codec
7-bit video
IC4 2203 Video processor
Chroma
Luma
½IC3 2133 Video codec
R
G
B
IC401 TEA5101 RGB output
CRT cathodes
Tuning voltage
IM bus
IM bus
Beam limiting
IC6 MEA2091 Tuner control
Tune up
Tune down
IC7 2070 CCU
IM bus
IC2 2540 Deflection processor
Line driver and output stages
EHT
Focus
A1
200V
26V
Scan coils
CRT heater supply
IM bus
IC11 TDA2170 Field output
Scan coils
Remote commands
IC501 TBA2800 Preamp
Clock
Mains input
IC1 etc. Power supply
120V
33V
20V
18V
12V
5V
Customer controls
IC8 MDA2062 EEPROM
17·7 MHz
IC5 MCU2632 Clock generator
Standby supply
5V
D842

Fig. 1: Block diagram of the Fidelity ZX5000 chassis.

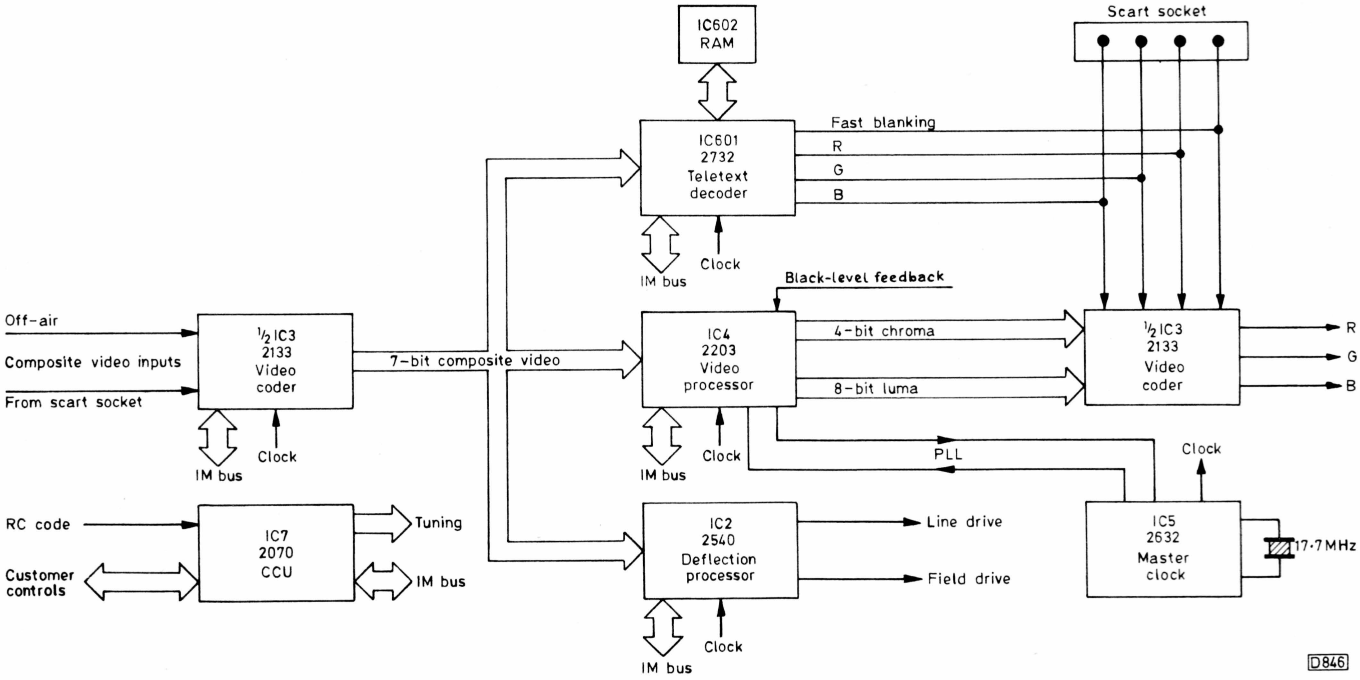

IC602 RAM
Scart socket
Fast blanking
R
G
B
IC601 2732 Teletext decoder
IM bus
Clock
Black-level feedback
Off-air
Composite video inputs
From scart socket
½IC3 2133 Video coder
7-bit composite video
IC4 2203 Video processor
4-bit chroma
8-bit luma
½IC3 2133 Video coder
R
G
B
Clock
IM bus
IM bus
Clock
PLL
Clock
RC code
IC7 2070 CCU
Tuning
Customer controls
IM bus
IC2 2540 Deflection processor
Line drive
Field drive
IC5 2632 Master clock
17·7 MHz
IM bus
Clock
D846

Fig. 2: Block diagram of the digital signal processing sections of the receiver.

other TV standards and eventual incorporation of NICAM 728 stereo sound.

Audio Circuit

The audio output from pin 26 of the i.f. module is passed to a conventional TDA1013A audio amplifier chip. For volume control purposes however a digital-to-analogue converter chip is required to interface the digital control system and the TDA1013A chip. DA conversion is carried out by an MEA2050 chip (see Fig. 4) whose analogue voltage output at pin 5 controls pin 7 of the TDA1013A.

Tuning System

Much of the frequency synthesis tuning system is incorporated in the 2070 central control unit chip IC7, i.e. the

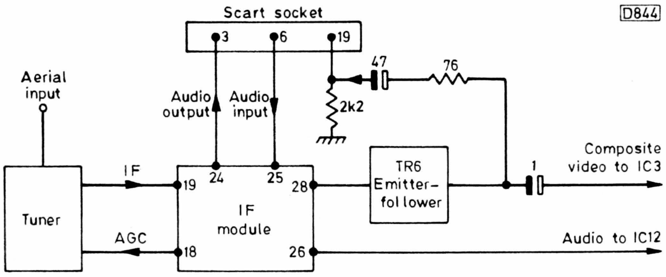

Scart socket
D844
3
6
19
Aerial input
Audio output
Audio input
47
76
2k2
Composite video to IC3
1
IF
24
25
19
28
TR6 Emitter-follower
Tuner
IF module
AGC
18
26
Audio to IC12

Fig. 3: Block diagram of the tuner and i.f. sections of the receiver.

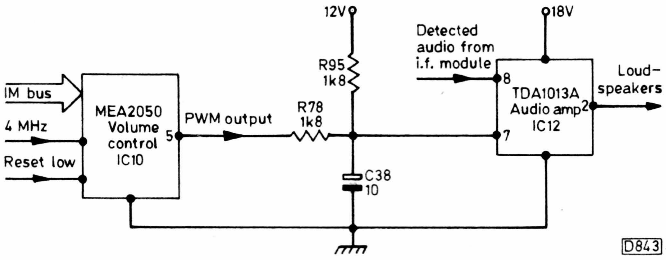

12V
18V
Detected audio from i.f. module
R95 1k8
Loud-speakers
IM bus
4 MHz
Reset low
MEA2050 Volume control IC10
5
PWM output
R78 1k8
8
TDA1013A Audio amp IC12
2
7
C38 10
D843

Fig. 4: Block diagram of the a.f. section.

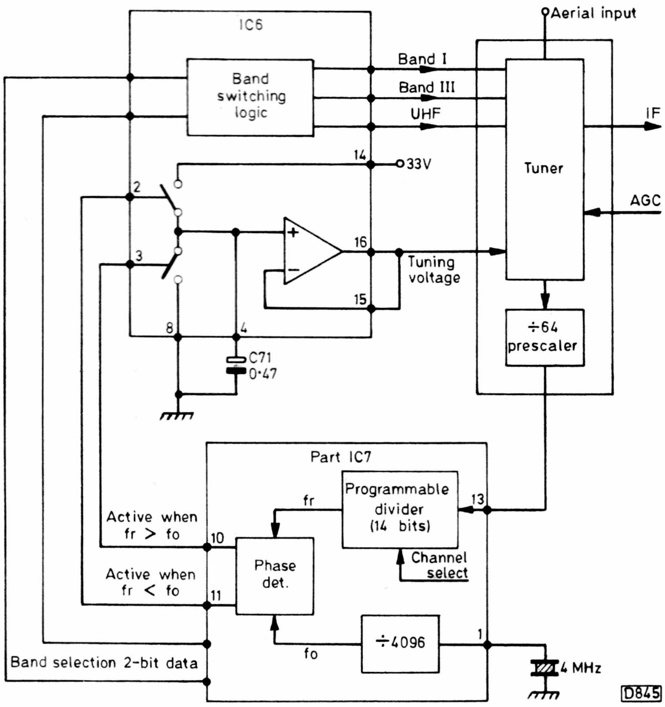

IC6
Aerial input
Band switching logic
Band I
Band III
UHF
IF
14
33V
Tuner
AGC
2
16
3
Tuning voltage
15
8
4
÷64 prescaler
C71 0·47
Part IC7
Programmable divider (14 bits)
fr
13
Active when fr > fo
10
Phase det.
Channel select
Active when fr < fo
11
÷4096
1
fo
Band selection 2-bit data
4 MHz
D845

Fig. 5: The frequency synthesis tuning system.

receiver's control system microcomputer chip. In addition, a tuner control interface chip (IC6, type MEA2091) and a 1:64 prescaler (divider) which is incorporated in the tuner unit are required – see Fig. 5. The prescaler's output, at one sixty-fourth of the tuner's local oscillator frequency, is applied to pin 13 of IC7. Within the CCU a programmable divider, controlled by the programme selection part of this chip, acting on instructions from the customer controls or the IR remote control system, adjusts the division ratio to produce an output frequency of 976·6Hz. This frequency forms one input to a phase detector: the other input is obtained from a 4MHz reference oscillator who's output is divided by 4,096 to again give 976·6Hz.

The phase detector's output consists of a series of positive-going pulses on one of the two lines that go to the electronic switches in IC6. If the sample frequency from the programmable divider is higher than the reference frequency from the crystal reference oscillator, positive-going pulses appear at pin 10 of IC7 and operate the electronic switch between pins 3 and 8 of IC6. Momentarily closing the switch decreases the charge on the hold capacitor C71. This reduces the voltage at the non-inverting input to the following amplifier, in turn reducing the voltage applied from pin 16 of IC6 to the voltage-controlled oscillator in the tuner. The oscillator frequency is thus altered until once again 976·6Hz is produced at the output from the programmable divider. When this condition has been achieved the pulses from pin 10 of IC7 cease and the selected channel is on tune.

In the event of the tuner's local oscillator frequency being lower than the desired frequency pin 11 of IC7 supplies pulses to pin 2 of IC6 so that the charge on the hold capacitor C71 is increased. Should the tuner's local oscillator drift during operation of the receiver the circuit provides error correction to keep the channel on tune.

Digital Processing System

We now come to the digital signal processing arrangements, which are shown in block diagram form in Fig. 2. Seven integrated circuits are involved. IC5 provides a 17·7MHz master clock signal which is the "heart-beat" of the whole system. The clock frequency is four times the colour subcarrier frequency and is locked to the colour burst by a phase-locked loop. Two of the i.c.s form the teletext decoder (IC601, type TPU2732) and its associated eight-page memory (IC602, type KM4164B-15). Another two, the video codec and video processor, provide digital PAL signal decoding etc. The deflection processor chip IC2, type 2540, provides synchronisation and the field and line drive waveforms. The video, deflection and teletext signal processing chips are all under the control of the 2070 CCU chip IC7. Control is applied via the IM bus (named after i.c. manufacturer Intermetall): this is a three-track bus with clock, data and ident lines.

Composite video from the i.f. module or the scart socket goes first to the 2133 codec chip. Codec stands for code-decode. This chip is mainly concerned with analogue-to-digital and digital-to-analogue conversion of the video signal. Selection of off-air or external composite video is carried out by an on-chip electronic switch which is operated by calling up the appropriate channel number via the on-board user or the remote control system. In the coder section of the chip the video input is sampled at 17·7MHz to produce a 7-bit digital output encoded in Gray code. The latter, which is used by teleprinters, is employed in preference to BCD (binary coded decimal) as it involves only one change in the states of the lines from one decimal number to the next. Gray code also has the advantage that it's easily converted to binary.

The digitally encoded video signal is then passed via a 7-bit bus to the teletext decoder, video processor and deflection processor chips. The major effect on the received picture of digital processing is to produce an extremely steady display under severe noise conditions. In such circumstances this in itself produces a subjective improvement in the picture quality.

The teletext decoder is extremely compact, with only a handful of components in addition to the two i.c.s. The KM4164B-15 memory chip is a 64K RAM that stores eight pages – the one being watched plus another seven. This is not a Fastext arrangement but offers storage of the seven additional pages fully under the user's control. The teletext decoder also produces on-screen displays to indicate the status of the user controls etc.

The teletext decoder's output consists of RGB and blanking signals which are passed to the decoder section of the codec chip for digital-to-analogue conversion. RGB inputs from the scart socket are fed to the codec chip's internal electronic selector switching – a point which could help with troubleshooting.

IC4 carries out video signal processing, i.e. separation of the luminance and chrominance components of the composite video signal, luminance signal processing (delay, peaking and contrast control) and decoding of the PAL signal to colour-difference output form. Its outputs to the decoder section of IC3 consist of 4-bit multiplexed colour-difference signals and 8-bit luminance – the latter allows for 256 shades of grey. Current sampling at the c.r.t. cathodes enables full auto grey-scale control of both background and drive, though some manual adjustment – via the CCU – is permitted to cater for individual customer preferences.

The decoder section of the codec chip demultiplexes the colour-difference input signals and then carries out matrixing with the luminance input to produce digital RGB signals for DA conversion. This chip also handles beam limiting, while internal switching selects between the off-air video, teletext and scart socket inputs.

The Timebases

The 2540 chip, which provides timebase synchronisation and the line and field drive waveforms, is clocked at 4MHz by the CCU chip and at 17·7MHz by the master clock chip. The line drive output at pin 31 is capacitively coupled to a conventional line driver and line output stage. The former uses a BD139 transistor which is operated at 18V and is transformer-coupled to the BU508D line output transistor. A diode-split line output transformer is used, with extra diodes providing 200V and 26V supplies.

Pin 27 of the 2540 chip provides a pulse-width modulated field drive waveform. The sawtooth drive required by the TDA2170 field output chip is obtained by integrating the PWM waveform – an *RC* network, R61/C47 (see Fig. 6), is used for this purpose. The 2540 also provides a ramp reset output at pin 26: this is used to discharge C47 to 0V at the end of each field. Pin 7 of the TDA2170 drives the scan coils, with the 2,200μF coupling capacitor C36 on the earthy side as is the custom nowadays.

Overall Control

The entire operation of the receiver is monitored and controlled by the CCU chip IC7 (see Fig. 7). Earlier on we described it as a microcomputer chip. It's actually rather more than this, containing in addition much of the tuning system, the IM bus control arrangement and interfacing with the front panel controls, the infra-red remote control receiver, power supply and customising EEPROM (IC8). The IM bus's ident line is used to identify the type of signals being carried on the data line: for the transmission of address information the ident line goes to zero, while for data as such it goes high to one. At the end of a data item the ident line momentarily goes low to indicate the end of the data transmission. The signal processor chips and the CCU are able to talk to each other via the IM bus.

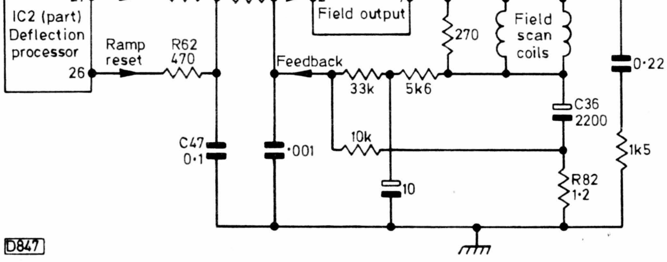


Fig. 6: Field timebase arrangement.

The MDA2062 EEPROM IC8 is a non-volatile memory which contains the data necessary to customise the receiver for its particular range of facilities. It also includes the brand name and the receiver's serial number – a useful feature in the event of a receiver becoming stolen property.

RGB Output Chip

An innovative feature of the set on the analogue side is the use of a TEA5101 chip (IC401) instead of discrete component RGB output stages. IC401 is mounted on the c.r.t. base panel with a substantial heatsink.

Power Supply Circuit

A conventional shunt-mode chopper power supply, see Fig. 8, provides 120V, 18V, 12V and 5V outputs. In addition a small mains transformer with rectifier and regulator provide an auxiliary 5V standby line. This supply is also used to operate the LED in a TIL111 optocoupler (IC13) which is driven by TR7. When the remote control unit gives the standby command pin 5 of the CCU goes high, turning on TR7 and illuminating the LED in the optocoupler. The associated photodiode then turns on, pulling pin 1 of the chopper control chip IC1 low. This turns off the drive to the chopper transistor. Reverse action takes place when the receiver is switched on again by signalling a channel number from the remote control unit. Regulation is achieved in the normal manner, by varying the mark-space ratio of the chopper drive, and the chopper circuit provides mains isolation. IC1 is synchronised to the line frequency via capacitor C102 (22pF, 4kV) which forms part of the receiver's mains isolation barrier.

The mains switch has a third set of non-latching contacts. These are used to hold TR7 off when the receiver is energised from cold and also from the standby mode. The optocoupler is manufactured to provide a high degree of insulation, forming an essential part of the mains isolation barrier along with C102 and the chopper transformer.

Servicing

The use of digital signal processing enables many of the usual preset controls to be eliminated, e.g. height, width, linearity, shift, grey scale and the colour decoder reference oscillator. Data on these parameters is held in the EEPROM (IC8) in the ZX5000, and can be altered to satisfy customer preferences, compensate for component ageing, etc. This facility is referred to as the "electronic screwdriver", and offers the advantage that most of the important adjustments can be made from the front of the set using the remote control system.

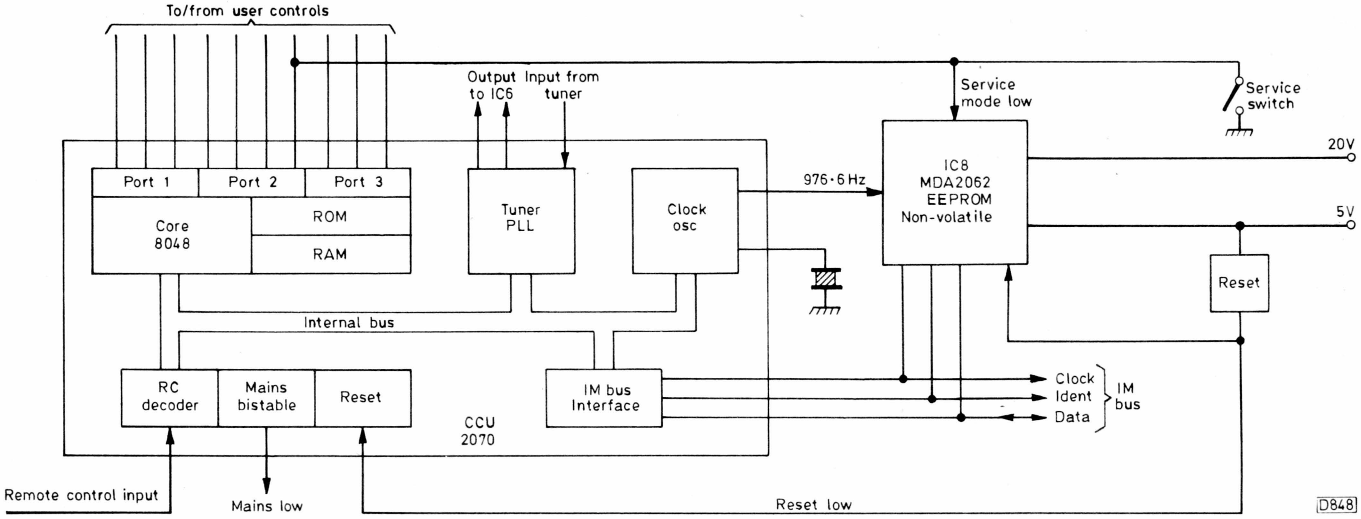

To/from user controls
Output to IC6
Input from tuner
Service mode low
Service switch
20V
5V
Port 1
Port 2
Port 3
Core 8048
ROM
RAM
Tuner PLL
Clock osc
976·6Hz
IC8 MDA2062 EEPROM Non-volatile
Reset
Internal bus
RC decoder
Mains bistable
Reset
IM bus Interface
CCU 2070
Clock
Ident
Data
IM bus
Remote control input
Mains low
Reset low
D848

Fig. 7: Block diagram of the 2070 central control unit chip and its associated EEPROM.

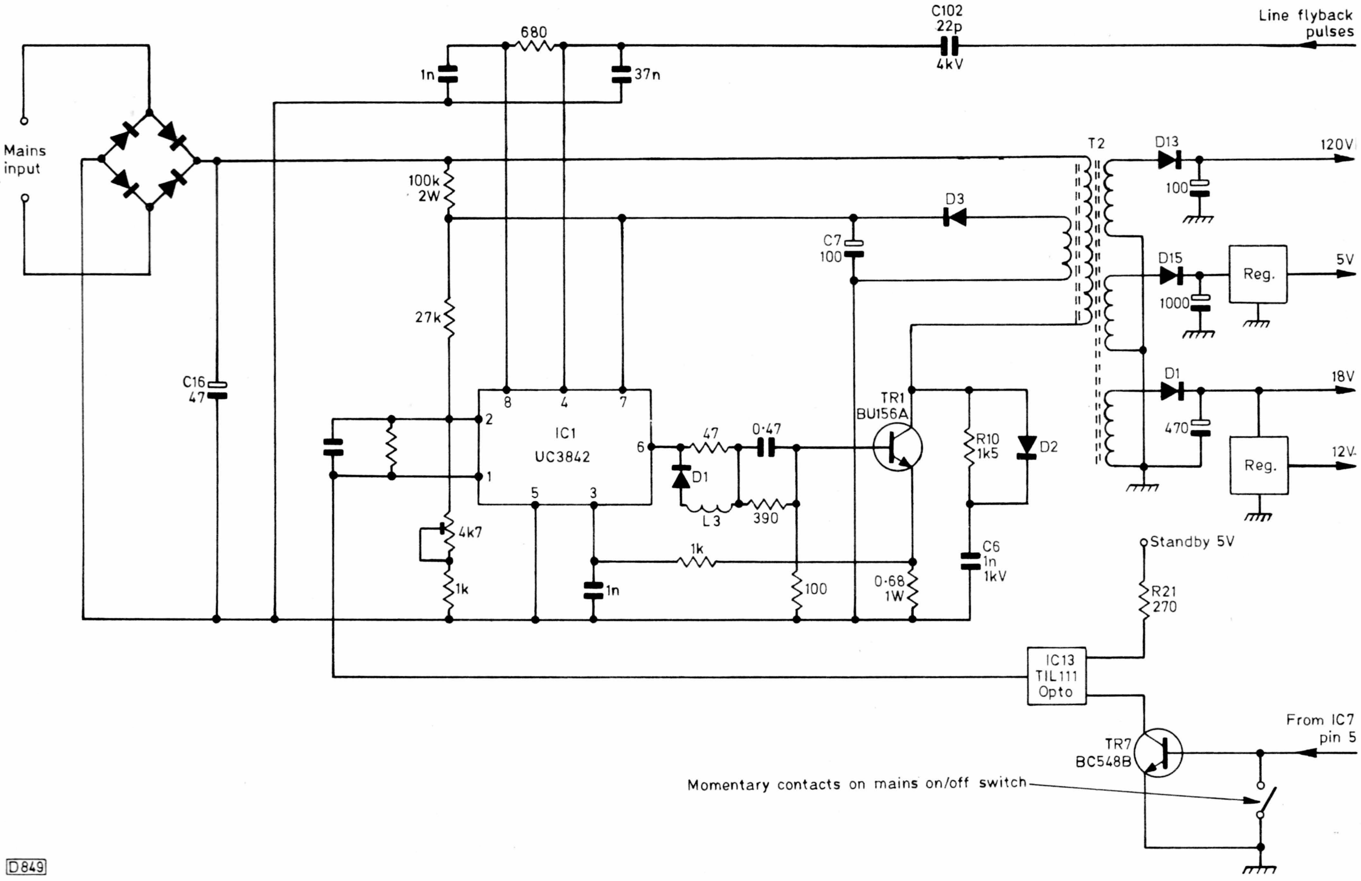

C102 22p 4kV
Line flyback pulses
680
1n
37n
Mains input
T2
D13
120V
100
100k 2W
D3
C7 100
D15
Reg.
5V
1000
27k
C16 47
TR1 BU156A
D1
18V
470
12V
Reg.
IC1 UC3842
8
4
7
2
1
5
3
6
47
0·47
D1
L3
390
R10 1k5
D2
4k7
1k
1k
1n
100
0·68 1W
C6 1n 1kV
Standby 5V
R21 270
IC13 TIL111 Opto
From IC7 pin 5
TR7 BC548B
Momentary contacts on mains on/off switch
D849

Fig. 8: Simplified circuit of the chopper power supply.

The service mode is entered by depressing the handset's channel key whilst holding down the service button at the rear of the receiver's chassis. A flashing box appears on the screen to indicate that the service mode has been entered. In addition to the following items, the first anode voltage can be set correctly by watching an on-screen indicator: horizontal shift; vertical shift; height; field linearity; field symmetry; luminance/chrominance fit; chroma reference oscillator; red cut-off; green cut-off; blue cut-off; red drive; green drive; blue drive.

Any readjustments can be stored individually as they are made, stored without stepping to the next one, or not stored at all. This last option is useful when you want to test the effects of changing one or more adjustments without altering the existing settings permanently. After storing (or not as the case may be) the new settings the service mode is cancelled by switching the receiver off.

The ZX5000 will naturally present a new and unique set of problems to the service engineer. It's interesting to speculate on how the digital circuitry will behave towards the end of a receiver's life, when the automatic compensation systems hit the end-stops! Will this receiver help to eliminate the need for service engineers? I think not. Whether digital or not the chips can still fail – readers of TV Fault Finding will have noted several references to the ITT Digi 3 chassis recently. So can other components, and of course the power-handling circuits remain in analogue form.

VCR Clinic

Reports from Christopher Holland, Alfred Damp, Philip Blundell, Eng. Tech., Roger Burchett, Steve Beeching, T.Eng. and Eugene Trundle

JVC GRC1

The problem with this camcorder was a scraping noise at about one second intervals during play and record. If pause was selected during play the noise stopped, so the drum assembly could be eliminated as this was still turning. The noise intervals were too fast for the take-up spool drive but seemed to be consistent with the pinch roller speed.

The workbench was cleared and a silent prayer was offered up along the lines "Please God, let this go back together again afterwards". In the event the noise was due to the capstan flywheel rubbing on the capstan generator board. It had worn through the protective lacquer, exposing the copper tracks beneath, but thankfully hadn't worn through the tracks themselves. The plate on which the capstan generator is located had a slight but definite bend: straightening this restored silent running. The owner later commented that the noise started only after lending the camcorder to a friend. I've since noticed that the same noise can be induced in this model if extreme pressure is applied to the cabinet directly beneath the capstan flywheel. This is the part that lies against the side of your head during use – maybe the owner's friend just had hard ears. **C.H.**

ITT VR3906/JVC HRD140/Ferguson 3V44

During playback this machine would periodically return to the stop mode. It might run for an hour or it might refuse to run for more than a few seconds. In the fault condition the rewind and fast forward functions would also cut out. Suspicion immediately fell on the take-up reel sensor, which has given trouble in the past, and sure enough the 6V peak-to-peak pulses were missing when the fault was present. A replacement sensor was ordered and fitted – but the problem remained.

The small PCB on which the sensor is fitted was unscrewed, and I started at it in disbelief. With the machine in this condition I selected play and as I watched the mirrors on the take-up spool turn I saw the letter D pass through the chassis aperture through which the sensor is activated. It was one of those stick-on letters that cassette makers supply with new tapes, and appeared to be catching on the edge of the chassis aperture from time to time, thus blocking out the sensor. I've often fished these letters and numbers out of VCRs, but this is the first time that one of them has caused a fault. **C.H.**

Amstrad VCR7000

This machine came from a TV repairer with the complaint no colour though monochrome recordings were o.k. No fault could be found in the colour circuits, apart from the fact that the 40FH a.f.c. potentiometer ran out of range. I then found that the 9·3V rail was at 7·11V – yes, I know, I should have checked the supply lines first. After restoring it to 9·3V the rest of the settings were found to be all to cock. Much time had to be spent setting the record a.g.c., E-E level, white clip, dark clip, carrier, deviation and luminance playback level controls. We've had this sort of problem before, haven't we?

It seems to me that owners of what I'll refer to as low-cost recorders tend to take them to dubious low-cost repairers – or a relation. They come back with an apology that the cause of the problem can't be found, though a charge is made for trying. The machine then comes to someone like E.T. or me to sort out, only to find that the phantom twiddler has been at work. The next hurdle is that the owner can't see why he has to pay something like a third of the purchase price for the repairs and subsequent setting up. If the machine had come to me in the first place the cost of the repair would have been more in the £30 region.

I might add that after investing in a lot of equipment the charge I have to make is £25 an hour and it matters little to me whether the machine is an £800 JVC or a £250 Taiwan special. It still costs the same to repair – and in a lot of cases the spares for the more expensive models are cheaper. Two examples: JVC spares are cheaper than anything from Mastercare; a set of VEH218 heads for a Panasonic NV370 cost £34·50 while the heads for the Philips clone cost £49·96. Work it out for yourselves **S.B.**

Ferguson 3V29/JVC HR7200

Intermittent failure to play was the fault noted on the job card – but it wasn't the only one! There were E-E signals but no deck functions – and the cassette lamp was on . . . A quick check around IC2 on the mechacon board revealed that the microcomputer chip was permanently reset (haven't had a reset fault since I last saw a Midway Space Invaders). The reset pulse is generated by IC3, but this and most of the surrounding components had already been changed – all except D21 which was open-circuit.

We now had play but no reel drive – IC12's circuit protector had blown. I was then left with the fault I at first expected – a slipping loading belt. What a saga! **P.B.**

Amstrad VCR4500

Several of these machines have come in recently with the same fault: after playing for a few minutes the tape rides down the capstan, giving loss of sound and a picture with tracking lines. It creases the tape a treat! The pinch rollers appear to be o.k. but the take-up torque is excessive. So far replacement of the large clutch drum has done the trick. Don't forget to mark the position of the mode control switch before removing the large plate! **P.B.**

Saisho VR1000

These machines are beginning to come in with idler problems. Roughening the tyre with wet-and-dry has so far provided an effective cure, which is just as well as replacement idlers have only just (October) become available. **R.B.**

Mitsubishi HS306

In this model most of the function controls are mounted vertically on the main board and are thus likely to be damaged as a result of heavy-handed use. I recently had to change the play and rewind controls: they worked all right but due to heavy use they had holes impressed in them and the customer controls wouldn't operate them.

The movement of the switches and the plastic bracket that retains them is such that heavy use flexes them back from the vertical and increasingly heavy pressure seems to be necessary to get them to operate. Once the damage has started it's inevitable that it will continue. Some people will always use unnecessary force and I think it was a mistake to mount the controls in this way. **R.B.**

Panasonic NV2010

This machine came in because the capstan was running slow. By the time the machine was put on the bench it had no clock display and a hum bar in the E-E mode. When the machine had been powered for about fifteen minutes the hum bar had all but disappeared and the clock was trying to flicker. Checks on the supply lines showed that the 18V and capstan 18V lines were low at 14V. Replacing C1009 (1,000μF) cured all faults. **A.D.**

Ferguson 3V54

No colour with this machine was traced to a faulty low-pass filter, LPF301. **A.D.**

Mitsubishi HS337

The indicator light wouldn't come on when the operate button was pressed, but the clock display changed from clock to counter as usual, reverting to clock after approximately five seconds. We found that the microcomputer's power-on pin went low and returned to its off setting after five seconds.

All the unswitched supply lines were correct: the problem was to check the switched lines in less than five seconds. This problem was dealt with by removing the control transistor Q9A3. Once this was done all the switched lines with the exception of the 5V line came up. The problem was due to a defective joint at the emitter of Q9A2. **A.D.**

Sony SLC6

The tape speed in the picture search and play modes was roughly the same. We found that the voltage across the reel motor was the same in both modes, but the service manual told us that this was correct. The cause of the fault was traced to the fact that the reel motor was being loaded by the relay pulley and spindle, which was binding on the bearing (drive transfer from the reel motor to the top of the deck). Cleaning and lubricating the spindle and bearing cured the fault. **A.D.**

Hitachi VT17/19/57/86/88

Some machines in these ranges can suffer from contamination of the capstan shaft bearings. It seems to be due to dust or tape debris finding its way past the sealing washer at the bottom of the capstan – perhaps they were not all pushed down fully at the factory.

The effects vary: chewed tapes, poor or no frame advance, or a loop of tape left hanging from the cassette lip. The cure is to remove and clean the capstan shaft and bearings. Also ensure that posistor PH1151 reads less than 4·7Ω at room temperature. If not, replace it. **E.T.**

Sony CCD-V100E

This second-generation Video 8 camcorder is a remarkable machine – it includes time-lapse recording and wipe effects amongst its repertoire of tricks. Far from providing time lapse, this one was doing things in double-fast time! The threading motion was normal, but thereafter the rotation of the reels, and the capstan from which they are driven, was somewhat prestissimo . . . The trouble lay in the direct-drive capstan motor, whose FG generator had gone on the blink. Replacing the capstan motor in this machine is an interesting task, involving removal and replacement of the threading ring as well as many of the underside PCBs. **E.T.**

JVC HRD180

We've had some mains power interruptions here lately. This was the reason why two identical machines came to be sitting side by side on the in bench, with identical complaints: no display at all, and no record. When tested both machines worked perfectly in all respects. Two more cases of microcomputer lock-out! The microcomputer chips were obviously reset when the machines were powered up and switched on in the workshop. **E.T.**

Fisher FVHP520

A no-go fault in a VCR can be caused by a multitude of things, from a blown mains fuse to some fiendish problem or other. This no-go machine's loading motor was not being driven. Investigation showed that one of the motor-drive transistors, Q868, was burnt to a blob – for the very good reason that the control microcomputer chip was simultaneously giving load and unload commands! As well as the microcomputer chip and Q868 we felt it prudent to replace both the multi-switch chips IC862 and IC864. The loading motor itself was unscathed and cheerfully did its stuff when the repairs were complete. **E.T.**

JVC GXN7E

The owner told us that this camera produced no red. Certainly any bright red objects in its view were reproduced as bright blue on the monitor TV's screen. Now this camera is not very easy to check or service, because much of the circuitry is contained on daughter boards which are packed in a row and pin-soldered to the mother board.

Having overcome the physical access problem we found that the trouble lay in the 90°/270° subcarrier feed to the R-Y modulator on the PAL encoder board. The waveform at output pin 52 of IC01, the SSG (sync and subcarrier generator) chip, was sick. Replacement of the SSG module solved the problem and the only setting up required was to the fsc and fh trimmers – easily done. **E.T.**

Sanyo VTC5300

The job card simply said "will not play". In fact the E-E signal remained present with the machine laced up and operating in the play mode. Unusual! With the top cover removed we found that the capstan and head drum were running continuously, even when stop was selected with no cassette present.

In this machine many of the command outputs from the syscon microcomputer chip pass through a multi-inverter i.c., Q3008 (type TC4069). This chip had failed in a big way, with several of its output pins stuck high regardless of the input conditions. A replacement inverter chip cured the problem at much less cost than the microcomputer we initially suspected. **E.T.**

ECONOMIC DEVICES & QUICK SAVE T.V. SPARES

15/80H	3.30
15/85R	3.30
16039	0.79
16181	1.04
16182	1.04
16334	0.98
16335	0.94
16446	0.98
16600	1.38
16802	1.27
17052	5.61
17053	5.61
17074	9.30
17089	3.45
17127	3.51
17376	1.58
1N4001	0.04
1N4002	0.06
1N4003	0.06
1N4004	0.05
1N4005	0.05
1N4006	0.08
1N4007	0.07
1N4148	0.03
1N4448	0.05
1N5401	0.14
1N5402	0.15
1N5403	0.16
1N5404	0.15
1N5408	0.35
1N914	0.04
IR3403	5.00
1S1555	0.31
1S44	0.10
1S5012A	0.81
1S921	0.10
2N1303	0.38
2N2219A	0.33
2N2222	0.38
2N2646	0.80
2N2904	0.36
2N2905	0.59
2N2906	0.38
2N2926	0.15
2N3053	0.27
2N3054	0.99
2N3055	0.61
2N3442	1.56
2N3702	0.14
2N3703	0.18
2N3705	0.16
2N3706	0.14
2N3707	0.16
2N3711	0.13
2N3771	0.70
2N3772	1.71
2N3773	1.65
2N3819	0.42
2N3823	1.17
2N3904	0.62
2N3908	0.62
2N4101	1.73
2N4240	3.30
2N4444	0.99
2N5293	0.50
2N5294	0.50
2N5296	0.49
2N5297	0.50
2N5298	0.61
2N5771	1.18
2N6109	1.58
2N6130	0.80
2N6133	1.25
2N6180	0.95
2N6292	1.65
2N696	0.43
2N698	0.43
2SA1006	1.50
2SA1011	1.65
2SA1015	0.49
2SA1012	1.25
2SA1020Y	0.89
2SA1027R	0.45
2SA473	0.75
2SA766S	4.95
2SC1173Y	1.25
2SC1474	1.25
2SC1509	1.35
2SD1391RL	3.95
2SA1095	3.74
2SA1103	6.55
2SA329	0.40
2SA489	1.17
2SA490	2.25
2SA493	2.25
2SA562	0.57
2SA564	0.75
2SA614	4.88
2SA628	1.14
2SA639S	1.75
2SA659	0.49
2SA673	1.50
2SA684	1.61
2SA697	1.05
2SA699	1.75
2SA715	0.95
2SA747	10.74
2SA748	1.36
2SA817	0.65
2SA818	1.82
2SA835	2.50
2SA836	0.89
2SA844	0.65
2SA872	0.80
2SA884	2.15
2SA937R	0.97
2SA940	0.59
2SA940-2	2.14
2SA950	0.72
2SA951	1.75
2SA966-Y	1.16
2SA999	1.36
2SB774	1.15
2SB185	1.13
2SB375	3.87
2SB400	0.40
2SB405	1.03
2SB449B	6.98
2SB511	2.26
2SB54	1.39
2SB546	0.56
2SB56	2.80
2SB618A	2.22
2SB631	1.45
2SB643	0.80
2SB669	3.67
2SB681	3.96
2SB695	1.98
2SB75	1.04
2SB774	0.65
2SB819	1.13
2SC1034	6.75
2SC1050	5.06
2SC1096	1.16
2SC1104	3.98
2SC1106	4.54
2SC1114	3.25
2SC1116	4.95
2SC1124	1.28
2SC1129	1.65
2SC1131	0.64
2SC1158	3.33
2SC1162	0.55
2SC1172	2.22
2SC1195	5.80
2SC1212A	1.97
2SC1213	0.89
2SC1226	1.46
2SC1293	0.90
2SC1306	1.98
2SC1316	10.25
2SC1317	0.50
2SC1364	0.49
2SC1383	1.20
2SC1391	2.45
2SC1398	0.79
2SC1413A	3.05
2SC1446	1.25
2SC1447	2.07
2SC1475	0.60
2SC1505	1.00
2SC1514	1.69
2SC1573Q	1.25
2SC1578	8.74
2SC1583	0.50
2SC1617	3.89
2SC675	1.41
2SC1678	1.98
2SC1741	1.25
2SC1810	1.70
2SC1815	0.45
2SC1826	0.67
2SC1829	3.34
2SC1875	5.85
2SC1881K	2.98
2SC1893	3.02
2SC1906	0.98
2SC1921	1.37
2SC1923	0.30
2SC1929	2.25
2SC1942	1.65
2SC1945	7.99
2SC1959	1.18
2SC1957	1.09
2SC1953	1.93
2SC1962	1.93
2SC1969	2.04
2SC1983	2.00
2SC1985	1.55
2SC2009	0.34
2SC2029	2.33
2SC2028	2.11
2SC2063	0.99
2SC2078	3.11
2SC2073	2.25
2SC2085-Q	1.65
2SC2091	1.30
2SC2141	2.44
2SC2166	1.98
2SC2216	0.69
2SC2233	1.80
2SC2236	1.65
2SC2278	1.69
2SC2314	2.17
2SC2335+KIT	13.44
2SC2551	1.26
2SC2565	3.92
2SC2570	2.88
2SC2577	1.60
2SC2578	6.75
2SC2671	1.99
2SC2826	2.07
2SC288A	1.85
2SC3153	6.84
2SC372	1.40
2SC373	1.16
2SC383	1.33
2SC388	0.50
2SC394V	0.81
2SC403C	0.60
2SC41	2.19
2SC458	0.15
2SC495	0.92
2SC515A	2.85
2SC535	0.79
2SC536	0.33
2SC537	0.54
2SC605L	1.16
2SC620	0.95
2SC643A	1.54
2SC668	0.67
2SC681	4.40
2SC682	1.88
2SC684	1.65
2SC693	0.63
2SC710	0.69
2SC711A	0.50
2SC717	1.28
2SC734	1.43
2SC761-Y	0.95
2SC783	3.98
2SC790Y	1.85
2SC828	0.28
2SC867A	3.84
2SC876	0.96
2SC930	0.54
2SC935	4.13
2SC936	8.66
2SC940	4.68
2SD1128	2.90
2SD1138	1.00
2SD1273	1.56
2SD1453	1.40
2SD152K	2.64
2SD198	4.20
2SD234	0.49
2SD235	0.60
2SD24	2.29
2SD257	1.98
2SD292	2.59
2SD313	2.59
2SD325D	2.26
2SD348	16.13
2SD350	5.20
2SD350A	3.05
2SD353	8.94
2SD389	2.41
2SD401	1.40
2SD414	1.98
2SD471	2.13
2SD560	2.95
2SD588A	2.36
2SD600	3.25
2SD601R	0.65
2SD613	1.03
2SD621	12.85
2SD636	0.55
2SD639-R	0.72
2SD655	0.98
2SD657	3.50
2SD661A	0.80
2SD731	1.05
2SD773	0.60
2SD811	3.30
2SD823	1.98
2SD837	1.56
2SD841	2.60
2SD856	1.55
2SD857Q	1.84
2SD882	1.15
2SD894	1.63
2SD898	1.85
2SK105H	2.15
2SK152	2.50
2SK34	0.76
2SK41	1.07
2SK79	2.98
40408	0.50
40594	1.53
40636	1.43
4EX581	0.80
741	0.30
7805-T022	0.63
7806	0.73
7808	0.85
7812-T022	0.35
7815	0.64
7818	0.92
7824	0.64
7905	0.80
9368	10.70
AA133	0.12
AC133	0.12
AC123K	0.43
AC127	0.27
AC128	0.34
AC138	0.24
AC141	0.29
AC142K	0.35
AC151	0.28
AC176	0.30
AC179	0.28
AC183	0.72
AC187	0.39
AC187K	0.43
AC188	0.47
AC188-01	0.49
AC188K	0.43
AC193K	0.65
AC194K	0.65
AD140	1.06
AD143	1.93
AD145	1.60
AD161	0.30
AD162	0.30
AD262	1.25
AF114	2.47
AF115	0.79
AF118	1.20
AF127	0.50
AF139	0.53
AF178	1.45
AF179	0.55
AF180	0.55
AF181	0.53
AF186	0.53
AF239	0.43
AF279	0.88
AL113	1.36
AN115	3.98
AN155	1.89
AN206	2.58
AN208	3.55
AN210	2.28
AN211	3.25
AN214Q	1.50
AN234	5.92
AN236	3.78
AN239	4.68
AN240P	1.25
AN241	1.71
AN245	4.49
AN253	1.10
AN260	3.85
AN262	1.20
AN272	8.25
AN295	5.52
AN301	2.45
AN302	3.99
AN303	4.39
AN305	8.95
AN315	2.46
AN316	5.53
AN318	5.25
AN320	5.47
AN321	2.25
AN322	5.85
AN331	4.59
AN337	3.81
AN340P	1.17
AN355	5.98
AN362	1.50
AN370	3.95
AN5010	5.70
AN5111	2.92
AN5120N	4.50
AN5132	5.39
AN5250	3.98
AN5435	2.25
AN5610	5.50
AN5612	4.68
AN5613	4.63
AN5630	3.95
AN5701N	1.66
AN6250	2.95
AN6300	4.40
AN6310	8.74
AN6320N	4.28
AN6340	10.14
AN6341	2.02
AN6342	2.77
AN6363	16.00
AN6371	9.24
AN6387	10.65
AN6531	1.95
AN6551	1.35
AN6552	0.68
AN6610	2.40
AN6677	10.45
AN7111	1.25
AN7114E	8.54
AN7115	3.38
AN7120	4.65
AN7145	2.80
AN7146	4.35
AN7151	2.26
AN7156	2.85
AN7158	2.32
AN7218	1.64
AN7223	4.25
AU107	3.50
AU110	2.25
AU113	5.25
AY105K	2.08
AY106	1.09
BA524	8.21
B250	2.25
B40	1.55
BA130	0.14
BA1310	1.98
BA1320	1.38
BA1322	3.95
BA1330	2.75
BA145	0.19
BA148	0.25
BA154	0.40
BA155	0.12
BA156	0.05
BA159	0.08
BA182	0.24
BA222	1.66
BA302	1.24
BA311	1.32
BA312	1.45
BA313	0.76
BA317	0.08
BA318	0.02
BA328	1.65
BA333	1.37
BA335	6.27
BA5102A	2.86
BA511	1.95
BA514	2.20
BA521	2.52
BA524	8.94
BA526	7.98
BA527	2.98
BA532	1.46
BA536	2.05
BA6209	4.55
BA656	1.00
BA7100	11.35
BA841A	28.98
BA843	3.96
BA854	5.76
BAV18	0.21
BAV19	0.11
BAV20	0.35
BAV21	0.12
BAW62	0.11
BAX12	0.48
BAX13	0.11
BAX16	0.11
BC107	0.13
BC107A	0.11
BC107B	0.18
BC108	0.15
BC108B	0.15
BC109	0.12
BC109B	0.15
BC109C	0.12
BC113	0.14
BC119	0.36
BC126	0.23
BC132	0.14
BC135	0.14
BC137	0.18
BC138	0.34
BC139	0.28
BC140	0.45
BC141	0.34
BC142	0.23
BC143	0.19
BC147	0.08
BC148A	0.11
BC148B	0.13
BC148C	0.11
BC149	0.11
BC149B	0.13
BC153	0.14
BC154	0.14
BC159	0.36
BC160	0.40
BC161	0.28
BC168	0.36
BC169C	0.16
BC170	0.16
BC171	0.11
BC172	0.13
BC172B	0.27
BC173	0.17
BC174B	0.27
BC177	0.35
BC178	0.26
BC179	0.26
BC182	0.05
BC182L	0.10
BC182LB	0.07
BC183L	0.11
BC183LB	0.26
BC184	0.13
BC184L	0.14
BC184LB	0.26
BC186	0.27
BC187	0.28
BC204	0.16
BC207	0.14
BC212	0.11
BC212B	0.26
BC213L	0.10
BC213LB	0.15
BC214	0.10
BC214LB	0.26
BC225	0.40
BC237	0.10
BC237BJ	0.12
BC238	0.10
BC238A	0.13
BC238B	0.08
BC239	0.12
BC239B	0.25
BC251A	0.31
BC294	0.50
BC300	0.35
BC301	0.45
BC302	0.53
BC303	1.04
BC307	0.18
BC307A	0.08
BC308	0.18
BC308A	0.11
BC309	0.17
BC317A	0.13
BC327	0.15
BC328	0.10
BC337	0.09
BC338	0.10
BC368	0.24
BC440	0.69
BC441	0.44
BC454	0.36
BC460	0.42
BC461	0.35
BC462	1.15
BC463	0.64
BC477	0.37
BC478	0.22
BC479	0.41
BC532	0.28
BC546	0.08
BC547	0.10
BC548	0.10
BC549	0.10
BC550	0.10
BC556	0.10
BC557	0.10
BC558	0.10
BC559	0.10
BC559B	0.11
BC560C	0.14
BC635	0.30
BC636	0.28
BC637	0.24
BC639	0.20
BC640	0.24
BC879	0.49
BC880	0.31
BCX34	0.18
BCY70	0.30
BCY71	0.21
BCY72	0.20
BD115	0.34
BD116	0.70
BD124	1.31
BD124P+KIT	0.69
BD131	0.57
BD132	0.20
BD133	0.53
BD135	0.36
BD136	0.26
BD137	0.36
BD138	0.46
BD139	0.28
BD140	0.29
BD144	1.70
BD150	1.25
BD157	0.67
BD160	1.60
BD163	0.71
BD165	0.62
BD166	0.42
BD168	0.73
BD175	0.20
BD179	0.45
BD181	0.99
BD182	0.99
BD183	0.99
BD184	1.21
BD187	0.53
BD189	0.69
BD190	0.72
BD201	0.40
BD202	0.60
BD203	0.50
BD204	0.61
BD207	1.79
BD208	0.34
BD222	0.38
BD225	0.49
BD228	0.63
BD229	1.05
BD232	0.50
BD234	0.42
BD237	0.47
BD238	0.39
BD239	0.45
BD240	0.57
BD241	0.39
BD242	0.39
BD243A	0.35
BD243C	0.29
BD244	0.45
BD244C	0.79
BD245C	0.99
BD246C	1.25
BD253	1.05
BD278A	0.60
BD317	2.60
BD318	2.85
BD375	0.42
BD380	0.76
BD410	0.52
BD433	0.47
BD434	0.49
BD435	0.49
BD436	0.60
BD437	0.49
BD438	0.40
BD441	1.42
BD442	1.41
BD509	1.65
BD510	0.62
BD519	1.50
BD529	0.80
BD530	1.18
BD533	0.67
BD534	0.53
BD535	0.79
BD536	0.61
BD537	0.80
BD538	0.80
BD544B	0.83
BD598	1.25
BD677	0.69
BD679	0.57
BD680	0.76
BD681	1.48
BD696	2.47
BD699	3.49
BD700	3.70
BD707	0.98
BD709	1.05
BD710	0.80
BD809	0.85
BD810	0.69
BD879	0.74
BD880	0.79
BD895	2.31
BD899	2.48
BD901	0.79
BD902	0.84
BDW83C	1.45
BDW84C	1.56
BDX32	1.75
BDX53A	4.93
BDX53B	1.85
BDX54B	2.16
BDX62A	2.15
BDX63A	1.96
BDY20	1.21
BDY81	1.05
BF115	0.40
BF117	0.66
BF118	0.67
BF121	0.25
BF123	0.21
BF127	0.13
BF137	0.29
BF153	0.58
BF154	0.26
BF157	0.33
BF158	0.18
BF159	0.18
BF160	0.31
BF167	0.38
BF173	0.34
BF177	0.35
BF178	0.40
BF179	0.36
BF180	0.36
BF181	0.32
BF182	0.34
BF183	0.39
BF184	0.43
BF185	0.39
BF194	0.14
BF195	0.14
BF196	0.17
BF197	0.18
BF198	0.17
BF199	0.17
BF200	0.37
BF218	0.36
BF224	0.17
BF237	0.65
BF240	0.17
BF241	0.15
BF245	0.50
BF245A	0.52
BF245B	0.49
BF246A	2.52
BF255	0.20
BF256	0.38
BF256LB	0.42
BF256LC	0.82
BF257	0.34
BF258	0.36
BF259	0.34
BF262	0.28
BF263	0.57
BF271	0.34
BF273	0.20
BF274	0.20
BF324	0.35
BF336	0.33
BF337	0.45
BF338	0.33
BF355	0.31
BF362	0.62
BF363	0.60
BF371	0.50
BF391	0.25
BF417	0.84
BF418	1.87
BF422	0.29
BF423	0.52
BF450	0.35
BF451	0.29
BF457	0.41
BF458	0.33
BF459	0.52
BF460	1.45
BF469	0.22
BF470	0.55
BF471	0.33
BF472	0.33
BF479	0.35
BF480	1.38
BF491	1.99
BF495	0.64
BF506	0.43
BF509	0.41
BF523	0.24
BF532	0.45
BF596	0.18
BF597	0.27
BF694	0.22
BF757	0.64
BF759	0.47
BF761	1.05
BF762	0.50
BF869	0.47
BF870	0.30
BF959	0.42
BF960	0.49
BF970	0.50
BFR39	0.44
BFR61	0.92
BFR62	0.50
BFR79	0.29
BFR81	1.65
BFR86	1.08
BFR89	1.63
BFR90A	0.70
BFT42	0.43
BFT43	0.43
BFT84	0.40
BFW10	0.60
BFX29	0.34
BFX84	0.37
BFX85	0.41
BFX86	0.36
BFX87	0.55
BFX88	0.34
BFX89	0.44
BFY50	0.32
BFY51	0.25
BFY52	0.27
BFY79	0.49
BFY90	0.61
BLY49	2.20
BR100	0.29
BR101	0.65
BR103	0.55
BR303	1.15
BRC116	0.67
BRC300	2.01
BRC5296	0.77
BRC6109	0.83
BRC82	1.08
BRC83	2.19
BRC84	2.08
BRX44	0.60
BRX49	0.67
BRY39	0.69
BSS38	0.87
BSTB0140G	5.25
BSTC0246	6.99
BSTC0233	7.25
BSTCC0143	3.07
BSTD1043	2.85
BSV57B	3.49
BSW68	0.60
BSX19	1.29
BSX20	0.30
BSY52	0.50
BSY79	0.51
BT100A	1.61
BT108	1.45
BT119	1.76
BT120	2.17
BT121	2.48
BT123	1.98
BT151-800R	0.89
BTT6018	2.42
BTT8124	4.89
BU106	2.48
BU108	1.50
BU109	2.65
BU110	5.69
BU111Y	4.16
BU125	2.48
BU126	1.45
BU137	6.53
BU205	1.35
BU206	1.27
BU207	1.65
BU208	1.20
BU208/02	1.97
BU208A	1.12
BU208D	1.95
BU209	1.50
BU226	2.95
BU326	2.00
BU326A	2.20
BU326S	2.20
BU406	1.49
BU406D	1.79
BU407	0.82
BU407D	0.99
BU412	9.15
BU426A	1.13
BU500	1.45
BU508A	1.25
BU536	1.65
BU608	1.80
BU705	1.85
BU806	1.79
BU807	0.80
BU826A	2.15
BUW84	1.39
BUX84	1.00
BUX85	1.10
BUY69A	2.04
BY126	0.13
BY127	0.08
BY133	0.12
BY164	0.44
BY176	0.52
BY179	1.08
BY182	0.95
BY184	0.40
BY187	0.77
BY189	1.79
BY198	1.62
BY201/2	1.50
BY203/20	0.59
BY207	0.22
BY208	0.46
BY210-400	0.19
BY210-600	0.27
BY210-800	0.34
BY218	1.64
BY223	1.23
BY224-600	1.88
BY225-100	1.13
BY226	0.25
BY227	0.49
BY228	0.60
BY229-1000	1.12
BY229-600	0.92
BY255	0.69
BY295-600	1.03
BY298	0.36
BY299	0.45
BY407	0.90
BY409	1.49
BY448	1.35
BY713	0.65
BYW19/1000	0.69
BYW56	0.16
BYX10	0.29
BYX55-600	0.23
BYX71-600	0.90
BYX71-350	0.80
BYX94	0.16
BYY56	1.20
BZY93C30	1.86
BZY88 RANGE	0.10
BZX61 RANGE	0.18
BZX79 RANGE	0.10
C106D	0.46
C106M	0.76
C1129	0.58
CA3046	1.55
CA3089	0.83
CA3090AQ	3.25
CA3094	2.20
CA3131EM	2.95
CBF16848N-071	1.56
CD4001	0.34
CD4002	0.27
CD4008	1.35
CD4011	0.29
CD4012	0.24
CD4013	0.33
CD4016	0.46
CD4017	0.82
CD4020	1.23
CD4021	0.39
CD4023	0.28
CD4025	0.64
CD4028	0.84
CD4040B	0.85
CD4047	1.06
CD4049	0.46
CD4052	0.75
CD4066	0.20
CD4069	0.29
CD4070	0.66
CD4081	0.35
CD4093	0.72
CD4511	1.10
CD4528	2.04
CD4556	1.47
CR02AM-8	1.70
CV12E	4.09
CX095D	3.14
CX104	9.64
CX108	10.50
CX109	7.86
CX130	8.76
CX134	12.32
CX136	11.49
CX139	11.83
CX157	4.84
CX158	5.52
CX177	6.46
CX187	6.84
CX755	12.95
CX885A	6.85
DEC1	2.20
DEC2	2.20
DS3486N	4.33
DS3487N	4.95
E1222	0.40
E5024	0.28
E5386	0.25
E9003	0.46
E9005	0.50
ESM310BP	4.15
FND500	5.78
GC374	1.65
GD243	4.95
GF758	0.84
GH3F	1.82
HA11215	1.75
HA11211	2.53
HA11225	1.50
HA11226	10.44
HA11229	0.85
HA11235	1.75
HA11124	5.25
HA11244	4.02
HA11251	4.47
HA1125	4.29
HA1137W	2.87
HA1138	5.03
HA11414	5.65
HA1144	7.87
HA1156	1.16
HA1160	4.78
HA1166	1.96
HA1166X	6.43
HA1167	5.36
HA11706	3.61
HA11705	8.00
HA11703	4.22
HA11701	4.56
HA11710	9.50
HA11713	9.75
HA11711	20.16
HA11715	3.25
HA11714	9.75
HA11716	13.10
HA11725	18.26
HA11725MP	16.00
HA117555P	6.23
HA11781	19.90
HA1180	5.15
HA1196	7.43
HA13001	2.25
HA1306	2.26
HA1338	7.50
HA1339	2.33
HA13402	7.87
HA13342	2.65
HA13365	4.02
HA1366WR	1.50
HA1367	2.75
HA1368R	2.45
HA1368	2.07
HA1370	3.30

IF YOU DON'T SEE IT LISTED ASK FOR QUOTE. GIVE MAKE MODEL LOCATION. REMEMBER TO ADD 0.60p POST & HANDLING. ADD 15% VAT TO TOTAL

PO BOX 15, WOLVERHAMPTON, WV2 4AZ ☎ TEL 0902 712083

HA1374	4.80
HA1377	1.75
HA1389R	2.05
HA1389	2.39
HA1392	3.65
HA1394	3.95
HA1397	3.76
HA1398	2.95
HA1406	1.30
HA1452	0.85
HBF4030AF	2.48
HD14538	2.07
HD38702-A2	8.95
HD38750A53	11.78
HD38750A-7	7.25
HD38800A50	14.09
HD44801A05	19.98
HEF4001BP	0.67
HISH1010	8.59
HISH1004	6.00
HISH1002	9.50
HM6231	9.81
HM6232	10.65
HM6251	4.95
HM7103	4.85
HM9032	9.98
HM9012	3.22
HM9015	3.24
HT4207	17.16
HT4208	20.65
IN5401	0.11
IR2403	1.45
IR2C05	4.25
IR3P06	2.25
IR3P08	4.95
IR94558	6.25
IS751	2.85
ITT425	0.18
IZ0003GE	5.37
IZ0020GE	5.93
K174YP	3.46
KA2101	2.92
KC581C	6.32
KC582C	3.97
KC583C	6.63
L200CV	1.69
LA1201	1.02
LA1210	1.56
LA1230	1.10
LA1320	2.87
LA1352	1.75
LA1357N	11.07
LA1363	1.05
LA1364	3.02
LA1365J	0.95
LA1385	1.94
LA1387	8.10
LA3155	1.25
LA3301	1.65
LA3350	1.43
LA3361	3.89
LA3365	3.98
LA3390	5.52
LA4030P	3.16
LA4031P	3.20
LA4032P	2.35
LA4100	1.25
LA4101	1.30
LA4102	0.75
LA4112	0.56
LA4125	2.25
LA4138	3.45
LA4140	0.60
LA4192	3.48
LA4220	1.10
LA4250	6.75
LA4400	3.92
LA4420	1.72
LA4422	1.72
LA4430	1.56
LA4440	2.95
LA4445	3.95
LA4460	1.75
LA4461	2.95
LA4505	5.85
LA5112N	1.68
LA7020	13.86
LA7025	11.97
LA7027	10.92
LA7040	9.20
LA7042	3.90
LA7800	1.05
LA7801	1.30
LB1274	3.61
LC7800	9.20
LD3120	1.13
LD3150	2.75
LM1017N	1.75
LM1877	13.43
LM224	1.75
LM2808	6.25
LM2877	5.25
LM317CKC	1.00
LM324N	0.98
LM339N	0.35
LM340K	11.85
LM348N	2.15
LM380N	2.80
LM384N01	3.25
LM567CN	1.71
LM6402/011	10.23
LM6402A093	10.15
LM748	0.69
LM8360	3.87
LM8361	3.57
LR2612	11.95
LR3419	9.37
LR3471	9.37
LU1141	7.27
LU52012	5.95
LU52011	14.95
LU03112	12.37
M193	6.83
M21C	1.13
M23C	2.83
M293	6.95
M51102L	4.95
M5115P	5.24
M51203L	3.15
M51231P	0.95
M5134-9341	4.13
M51353P	5.25
M51381P	5.45
M51393AP	9.35
M51394P	14.05
M5142P	6.85
M5144P	2.97
M51513L	2.06
M51515BL	2.75
M51517L	2.90
M5192	2.20
M5194AP	5.74
M5231L	1.95
M53274P	1.33
M54532P	1.71
M54544L	3.45
M58478P	8.77
M58485P	13.65
MA06	1.07
MA8001	0.82
MA8003	1.16
MB3705	1.98
MB3712	1.85
MB3713	1.69
MB3730	2.94
MC13002	3.59
MC1310P	2.25
MC1327P	1.33
MC1330P	1.45
MC1350P	1.61
MC1351P	3.96
MC1352P	2.50
MC1357P	2.15
MC1358P	1.35
MC14001	2.40
MC14013	0.41
MC14493P	5.95
MC14494P	2.15
MC14497	3.15
MC14510BAL	3.75
MC14511BCP	1.10
MC14528BCP	2.15
MC1712	3.88
MC5192	19.50
MC7724CP	3.49
MC7818C	2.18
MCR100/7	1.65
MCR106-5/6	0.95
MCR220/7	2.28
ME0402	0.17
ME0404/2	0.47
ME0411	0.28
ME6002	0.26
ME6102	0.28
ME8001	0.34
ME0411	0.75
MJ2501	3.30
MJ3001	1.76
MJ481	1.53
MJ802	4.90
MJE2955	1.89
MJE3055	1.05
MJE340	0.49
MJE520	0.49
ML231	3.33
ML232B	3.65
ML237B	2.51
ML238	5.77
ML923	3.35
ML926	3.98
MM5314N	8.99
MM5316N	9.16
MM5318N	3.11
MM5369N	2.01
MM5387AA/N	6.20
MM5841N	6.64
MN1400VL	13.65
MN1405	12.95
MN1435VX	11.85
MN6016A	20.56
MP1192	5.07
MP2794	4.00
MP2812	5.07
MP8512	1.57
MPC596	2.13
MPF256C	0.60
MPS6570	0.48
MPSA42	0.65
MPSA56	0.27
MPSA92	0.72
MPSU05	0.86
MPSU10	1.45
MPSU56	0.78
MPSU60	1.98
MR818	0.33
MR854	0.72
MR914	1.20
MSM5816RS	17.35
MSM5840H	15.15
MVS460-02	0.61
NE542	2.65
NE545B	3.59
NE555	0.25
NE556	0.65
NE565N	1.33
NE645BN	3.35
NP1106	7.25
OA202	0.11
OA47	0.16
OA91	0.09
OA95	0.13
OC28	2.95
OC29	2.15
OC36	1.28
OC44	0.35
OC45	0.18
OC72	0.44
OC75	0.44
ON236	1.06
ON782	1.98
OT121	1.45
PT6042	2.45
PT8504	4.98
R1038	2.19
R1039	2.19
R2008B	1.33
R2009	1.98
R2010B	1.33
R2029	1.33
R2030	1.33
R2257	3.71
R2265	1.49
R2305	1.18
R2322	0.59
R2323	0.76
R2354A	2.01
R2354B	2.01
R2443	0.88
R2461	1.50
R2540	2.05
R2540X	3.30
R2615	0.67
RCA16029	2.01
RCA16600	1.38
RCA16802	1.08
RCA17074	6.60
RCA17376	1.58
RCA17524	0.83
RCA17523	0.83
RCA2060	2.00
RGP01-15	1.65
RGP10	0.30
RGP30M	0.28
RT402	1.58
RT905A	2.38
S1299	7.98
S175	31.48
S2062D	0.95
S2800D	5.54
S2802	3.47
S2818	0.85
S3702S	6.15
S40W	10.50
S6080B	8.80
SA8063	5.17
SAA1006	1.75
SAA1020	4.76
SAA1025	4.40
SAA1024	2.81
SAA1075	6.25
SAA1121	7.44
SAA1124	3.30
SAA1130	4.99
SAA1174	7.77
SAA1250	4.15
SAA1251	5.98
SAA11351	4.95
SAA3027P	2.55
SAA5000	2.50
SAA5010	3.65
SAA5012	5.28
SAA5020	5.78
SAA5030	8.25
SAA5050	7.74
SAB1009B	5.98
SAB3011	7.34
SAB3013	3.76
SAB3021	7.90
SAB3024	6.36
SAB3209	5.82
SAB3210	3.10
SAF1032P	5.50
SAF1039	3.35
SAS5010	8.39
SAS560S	1.86
SAS560T	5.42
SAS570T	5.42
SAS570S	2.61
SAS580	2.25
SAS6600	1.33
SAS660	2.97
SAS6700	1.33
SAS670	3.96
SAS6710	1.93
SBA750	1.61
SC84203	19.35
SC9504P	1.95
SDA2006	17.95
SDA2112/2	12.85
SG264A	6.45
SG613	10.75
SG629	8.27
SG6533	11.96
SI-1020H	10.89
SI-1125HD	17.63
SI1125H	7.50
SI1225HD	18.35
SI1630HD	20.50
SI6900	12.00
SKE1/02	1.85
SKE2F1/04	1.39
SKE2G3/04	1.05
SKE4F1/06	0.35
SKE4F2/08	0.80
SKE4F2/06	0.44
SKE4F2/10	1.24
SKE4G2/02	0.96
SKE5F3/10	1.60
SKS1/10	2.15
SL1310	3.14
SL1430T	2.32
SL414	3.69
SL432A	3.44
SL439	2.48
SL471	4.78
SL480	3.98
SL490	1.25
SL901B	6.95
SL918A	6.98
SN16861AN0	1.65
SN16862AN	2.98
SN16966N	10.25
SN29717N	7.19
SN29716N	3.66
SN29715N	6.04
SN29722	11.95
SN29723AN	8.77
SN29764AN	1.65
SN29767	4.98
SN29770BN	1.95
SN29772BN	2.95
SN29771BN	1.65
SN29791	2.98
SN29798N	5.56
SN2709	0.44
SN7400N	0.34
SN7401N	0.36
SN7402N	0.65
SN7404N	0.52
SN7408N	0.27
SN7410N	0.27
SN74121	1.60
SN7413N	0.37
SN74141N	2.65
SN74151AN	1.51
SN74154N	1.27
SN74190	1.35
SN7420N	0.55
SN7430	0.49
SN7440N	0.27
SN7472	1.54
SN7474N	0.44
SN7490AN	0.93
SN74LS26N	0.53
SN76001N	1.65
SN76013ND	3.50
SN76023N	2.75
SN76023ND	3.96
SN76033N	3.65
SN76110N	0.90
SN76115AN	1.61
SN76131	1.92
SN76227N	1.33
SN76226DN	1.98
SN76228N	3.27
SN76242	8.95
SN76243	8.50
SN76396	2.90
SN76533N	2.47
SN76532N	0.95
SN76545	1.95
SN76546N	3.47
SN76549	2.59
SN76570	3.08
SN76611	2.59
SN76620	2.59
SN76660N	2.48
SN76666N	1.20
SN76708	4.86
SN76709N	3.30
SN76707N	5.11
SN76705N	6.60
SN76730	6.00
SN76810N	0.60
SN76832N	1.35
SN94041	5.54
SN94042	5.54
SP8385	0.55
SPS5384	1.98
ST1702L	0.99
STA401	6.76
STA441C	3.00
STA471C	7.56
STK0029	5.54
STK0039	5.11
STK0040	12.78
STK0050	7.72
STK0080	9.16
STK011	5.08
STK013	9.25
STK014	9.80
STK015	7.75
STK016	8.45
STK022	5.25
STK025	10.32
STK031	12.95
STK040	13.34
STK043	13.34
STK054	7.13
STK058	27.50
STK077	7.67
STK078	8.48
STK080	16.50
STK082	11.86
STK086	13.59
STK1039	5.75
STK2110	7.33
STK2145	16.25
STK2230	7.70
STK2240	15.65
STK2250	18.95
STK3042	4.95
STK3044	5.75
STK4019	4.50
STK430	10.55
STK433	6.25
STK4332	8.25
STK435	5.94
STK4352	1.95
STK436	4.70
STK437	9.65
STK4372	11.15
STK439	7.25
STK441	8.75
STK443	10.29
STK457	13.45
STK460	6.10
STK461	9.68
STK463	11.85
STK466	11.77
STK4833	16.95
STK501	6.32
STK502	5.40
STK5314	12.32
STK5730	2.99
STK7216	14.50
STK772	6.95
STR1096	5.45
STR4090	10.55
STR440	5.79
STR441	3.95
STR451	5.36
STR453	8.16
STR454	5.20
STR6020	4.95
T6029V	5.75
T6035V	0.73
T6036	0.67
T6037	2.11
T6044V	0.97
T6045	1.20
T6049	1.45
T6052V	0.87
T6058	3.08
T6059	2.77
T9003V	1.25
T9005V	2.38
T9011V	0.49
T9013V	7.22
T9014V	2.60
T9016	1.02
T9019W	1.98
T9034V	1.45
T9035V	1.95
T9051	6.95
T9054V	0.77
T9057V	0.70
T9062V	0.49
T9064	1.00
TA6002	4.35
TA7027	4.80
TA7050	1.74
TA7051	1.74
TA7054	2.55
TA7060AP	0.71
TA7061AP	1.27
TA7069	3.13
TA7070P	1.83
TA7072P	2.57
TA7073P	5.86
TA7074P	1.98
TA7076P	7.80
TA7089P	3.10
TA7092P	8.65
TA7093P	3.99
TA7102P	5.88
TA7108P	1.61
TA7109	3.71
TA7122B/P	0.92
TA7124P	2.34
TA7129P	1.50
TA7130P	1.27
TA7136AP	1.27
TA7137P	0.98
TA7141AP	3.87
TA7146	2.50
TA7146P	4.23
TA7148P	1.67
TA7149P	3.26
TA7152P	2.72
TA7161P	3.45
TA7162P	3.25
TA7169	7.80
TA7172P	1.41
TA7176P	2.48
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TA7203P	2.18
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TA7217AP	1.45
TA7222	1.95
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TA7229P	4.45
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TA7232P	6.60
TA7233P	3.15
TA7240AP	3.55
TA7245P	5.92
TA7270	2.25
TA7310P	2.15
TA7312P	2.45
TA7313AP	1.36
TA7314	5.94
TA7323P	3.15
TA7325P	1.15
TA7339P	1.85
TA7340P	5.95
TA7607AP	3.10
TA7609	3.91
TA7611AP	2.35
TA7616P	5.25
TA7622AP	12.87
TA7628P	5.06
TA7629P	7.50
TA7630P	0.95
TA7640AP	2.29
TA7672P	2.55
TA7676P	2.81
TA7726P	12.50
TAA320A	1.27
TAA350A	6.45
TAA570	1.74
TAA621AX1	4.85
TAA621A12	2.14
TAA661B	2.62
TAA691	8.58
TAA700	3.75
TAA930	4.87
TAA970	2.83
TAA110	2.52
TAG232-600	0.79
TAG626-600	1.20
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TBA120SB	1.05
TBA120T	0.65
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TBA120A	1.05
TBA1440	1.65
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TBA240A	2.65
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TBA395Q	1.10
TBA396	2.90
TBA400	2.39
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TBA480Q	1.30
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TBA520	1.15
TBA520Q	1.68
TBA530	1.30
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TBA540	1.15
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TBA560C	1.40
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TBA641B72	3.03
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TBA750Q	2.90
TBA760	1.71
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TBA920	1.53
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TBA940	1.87
TBA950	1.84
TBA970	3.56
TBA990	1.82
TBA990Q	1.68
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TC4011BP	3.50
TC4013BP	3.75
TC4016BP	3.15
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TC4081BP	3.25
TC40H000	1.98
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TC9002BP	11.34
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TCA420A	2.16
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TCA530	2.24
TCA640	2.25
TCA650	3.05
TCA660B	2.60
TCA730	3.81
TCA750	2.25
TCA800Q	6.95
TCA830S	2.38
TCA890	5.44
TCA900	2.04
TCA910	2.04
TCA940	2.47
TCA940E	2.93
TCE330	3.89
TCEP100Q	10.25
TCEP100	9.61
TD3406AP	3.98
TD3F800R	4.16
TD3F900H	4.16
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TD62104P	2.50
TD62706P	4.50
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TDA1200	1.50
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TDA1950	2.95
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TDA2006	1.55
TDA2004	3.49
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TDA2003	1.75
TDA2010	1.68
TDA2020	1.95
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TDA2170	2.88
TDA2270	2.25
TDA2510	7.85
TDA2520	2.37
TDA2522	3.46
TDA2524	4.50
TDA2521	3.71
TDA2525	3.80
TDA2532	2.50
TDA2530	2.55
TDA2541	2.48
TDA2540	2.15
TDA2545Q	5.94
TDA2560	0.75
TDA2575A	0.50
TDA2576A	3.00
TDA2571A	4.45
TDA2578A	2.57
TDA2576A+KIT	12.35
TDA2581	1.65
TDA2582	1.25
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TDA2600	6.50
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TDA3541	2.22
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TDA3590	5.79
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TDA3650	7.95
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TDA3651AQ	2.95
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TDA3651A	1.75
TDA3950	2.95
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TDA4290	4.47
TDA4400	2.27
TDA4420	2.55
TDA4422	3.65
TDA4427S	9.00
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TDA4442	4.15
TDA4500	4.75
TDA4600	2.50
TDA4610	1.78
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TDA5500	6.18
TDA5700	2.75
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TDA8190	2.47
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TDA9513	2.25
TDB1033	2.68
TDE1081	7.05
TE626	1.49
TEA1002	2.30
TEA1009	1.86
TEA1014	2.50
TEA1020SP	8.21
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TIC106M	0.57
TIC116Y100	2.07
TIC44	0.72
TIC45	0.50
TIC47	0.35
TIP120	1.06
TIP110	0.45
TIP112	0.54
TIP117	0.50
TIP121	0.45
TIP126	0.73
TIP132	1.40
TIP137	1.50
TIP29	0.84
TIP2955	0.95
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TIP29B	0.63
TIP29C	0.40
TIP29D	0.75
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TIP30C	0.16
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TIP31C	0.50
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TIP32B	0.69
TIP32C	0.40
TIP33	0.85
TIP33A	1.05
TIP33C	0.80
TIP34	0.50
TIP41A	0.49
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TIP41C	0.25
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TIP42C	0.25
TIP47	0.37
TIP48	0.92
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TIP55A	3.65
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TIS90	0.28
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TL494CN	8.95
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TMS1024NLL	13.75
TMS1025N	16.95
TMS3720ANS	19.50
TMS3748NS	14.95
TMS3755	13.65
TMS3894NL	19.25
TMS5102NLL	6.25
TUA2000	8.98
TV106	2.37
TY6010B	2.97
U05G	1.14
ULN2204	10.55
UPA53C	4.94
UPC1003	5.95
UPC1009C	8.95
UPC1025H	3.00
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UPC1042C	8.95
UPC1156H	4.50
UPC1158	5.84
UPC1161C	4.98
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UPC1181H	1.25
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UPC1188	7.40
UPC1212C	1.72
UPC1225H	3.25
UPC1230	1.78
UPC1238	4.09
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UPC1351C	1.81
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UPC1363	4.20
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UPC1365C	6.98
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UPC1360C	4.51
UPC1378H	1.25
UPC141C	3.75
UPC1458	8.66
UPC151C	2.95
UPC2002	1.48
UPC30C	2.51
UPC324C	4.17
UPC32C	5.25
UPC339C	4.35
UPC41C	4.10
UPC4558C	2.15
UPC474	5.11
UPC554C	1.85
UPC566H	2.95
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UPC575C2	2.40
UPC576H	2.58
UPC577H	1.25
UPC578C	8.70
UPC580C	4.13
UPC587C2	1.34
UPC592H	2.15
UPC595	2.95
UPC596	1.98
UPD1514C	8.95
UPD2819C	4.98
UPD4013B	4.00
UPD4066B	4.95
UPD553-164	19.25
UPD8049C-1	11.50
X0007TA	4.68
X0022CE	5.75
X0029CE	7.09
X0031CE	4.95
X0035TA	5.98
X0040TA	4.50
X0042CE	4.35
X0043CE	2.75
X0056CE	6.25
X0057GE	6.00
X0062CE	8.35
X0065CE	4.60
X0074GE	10.00
X0077GE	15.96
X0079CE	4.95
X0092CE	4.95
X0096CE	5.98
X0109CE	11.25
X0113CE	2.07
X0195CE	7.50
X0204CE	8.74
X0261CE	8.75
X1222AF	3.63
IX0111CE	2.95
Y969	0.82
TDA3310	2.15
ZPY120	3.25
ZTK33	0.43

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Helical Aerials for Band I

Roger Bunney

During the past year I've been conducting experiments into the use of helical aerials for DX-TV reception in Band I. Interest in this subject stems from a problem that a DXer reported to us – his local council instructed him to remove the DX-TV aerial system mounted on the gable of his house. This led us to consider alternative, "low-profile" aerial sytems that could be used where a council enforces strict controls on environmental grounds. What we were seeking was a viable alternative to the usual full-size Yagi array.

The helical form of construction seemed to offer possibilities, combining efficiency with small size. The compact, active aerial used in marine applications was discounted on the grounds of cost. This could however find application for Band III/u.h.f. use – a Triax design is to be assessed shortly. While we were initially thinking about helical aerials details of a compact, wideband v.h.f. aerial of Russian design came our way (see page 632, July 1987 issue). This appears to have remarkable gain/performance characteristics. A TV-DXer friend is at present building a prototype, and if the performance claims are substantiated we will be reporting further on this type of aerial.

On the helical aerial front I initially considered the use of a Les Wallen 27MHz CB design, with the output directly connected to a wideband aerial amplifier – this is facilitated by the fact that these Les Wallen aerials have SO329 terminations. The aerial was mounted vertically, and a two-aerial arrangement with horizontal stacking was also tried.

Despite the harmonic relationship with Band I (2 × 27MHz = 54MHz) these aerials provided very disappointing results above their designed-for frequency. While we were conducting these experiments Les Wallen informed us that they had put into production a 49MHz version of the aerial, intended for use in the UK paging band. It's known as the Saturn base station aerial. In all respects other than length it's similar to the CB version – the overal length is 18·5in. (approximately 0·5m).

Tests

Our initial reaction was that the aerial was far too small to work well. It was nevertheless erected at 40ft., using low-loss RG58 50Ω coaxial feeder, again with vertical mounting. During the first Sporadic E openings in 1987 it produced excellent results in comparative tests with the four-element, wideband Yagi array I've long used, mounted at 53ft.

The test results obtained were subjective, i.e. as viewed on the TV set's screen. No measurements were made, primarily because of the completely different aerials and heights, the fluctuating nature of the signals, and so on. The output from the main, Yagi Band I array was fed to a single tuning system/TV receiver (no amplifier) while the 49MHz Saturn aerial's output was fed to a similar tuning system via a Mutek v.h.f. amplifier with a gain of 10dB. With short/medium-hop signals, i.e. at up to 1,000 miles from the transmitter, the signals displayed by both receivers were of generally similar strength and quality, though the vertically mounted helical aerial seemed to do better – possibly because in many instances polarisation shift favoured vertical mounting. Signals received via the helical aerial were often not visible via the horizontally mounted Yagi array – or different signals might be received via this aerial. By and large the helical aerial/low-noise amplifier combination provided similar results to the Yagi array with short/medium-hop SpE signals. Long-hop signals tended to retain their horizontal polarisation however. As a result they were well received via the Yagi array and poorly resolved via the vertical helical aerial.

The next step in our experiments was to obtain a second helical aerial and mount it horizontally, to correct for the poor reception of horizontally polarised signals. This it did, sufficiently to enable a weak tropospheric ch. E4 Lopik (Holland) signal to be resolved at around 4dB lower than via the horizontally mounted Yagi array some 13ft higher!

The Saturn aerial claims to have a ±5MHz bandwidth centred at 49MHz. With a head amplifier providing mismatch swamping, the aerial's basic broadband nature allowed the whole of Band I to be covered efficiently. With vertical mounting the aerial's compressed construction increases the pick-up above the horizon, which helps with the reception of SpE signals arriving in this way, while reducing pick-up from interference sources below the system.

The Les Wallen aerials are well made. The 49MHz Saturn consists of a helical element wound within a black PVC tube, capped with PVC at the remote end. The cable outlet end has a well constructed two U-bolt mounting bracket and a short external aluminium tube. There's an exposed SO329 socket for feeder connection, taking a type PL259 CB plug. I was not too happy with this exposure and fitted a PVC electrical "boot" to prevent the possibility of moisture ingress. The aerial's length is approximately 18·5in., and the basic intention is that it should be vertically mounted.

Following the tests carried out during the 1987 SpE season I fitted a Fringe Electronics masthead Band I

The Les Wallen 49MHz helical aerial.

amplifier (I think Fringe must be one of the few manufacturers of single-band amplifiers – most have gone wideband at v.h.f.). This proved most useful. The latest Fringe models have noise figures of 2dB or lower at v.h.f.

Conclusions

In conclusion, the results achieved during the past SpE season confirm that the 49MHz Saturn helical aerial does offer a viable alternative to a conventional Yagi array, with results maintained across the whole of Band I. With short/medium-hop signals the results obtained with a vertically mounted aerial are if anything better than with a standard aerial array. With signals that have travelled from a transmitter 1,000 miles or more away a horizontally mounted helical aerial is needed to compensate for a vertically mounted aerial's poorer performance: where a non-rotating system is used it's best to mount two aerials at 90° to obtain omnidirectional coverage, with switching between the outputs. The output voltage will be less than that from a Yagi array but this can be made good by using an amplifier with a gain of about 10dB – aim for low noise rather than gain. The Les Wallen aerial has a VSWR of 1-1·5 or better with an output impedance of 50Ω. The manufacturers advise weatherproofing the output termination.

The Saturn can be recommended for the flat/apartment resident unable to erect an efficient, large Band I DXing aerial. With a wideband v.h.f. amplifier the aerial will provide some signal pickup outside Band I, though with reduced efficiency. The helical system is compact, is not intrusive, and resembles a small marine base transmitting aerial.

The 49MHz Saturn paging band aerial is made by Les Wallen Manufacturing Ltd., Unit 1, Trinity Place, Ramsgate, Kent CT11 7HJ (telephone 0843 582864). It is sold at around £25 inclusive in the UK. Send a s.a.e. with any enquiries. My thanks to Les Wallen for providing information and samples.

Since writing the above report a 55MHz version of the Saturn for DX-TV use has been introduced. It's available from Aerial Techniques at £22·75 inclusive.

The Philips 3A Chassis

Harold Peters

For the past decade the design of CTV timebase circuitry and, to a lesser extent, power supply circuitry has become pretty stable, the only significant changes occurring where mains isolation is required. So we've come to expect all the novelties to be at the front end — teletext, remote control and various types of synthesised tuning. Recently however Philips, with the objective of a "go anywhere, do anything" set, have produced a chassis that takes a new approach, with novelties right across the board.

Known as the 3A, the new chassis is incorporated in the latest Matchline range of receivers. In addition to all the features expected from Matchlines it provides on-screen display of channel, analogue control settings and user-programmable station identity in place of the familiar two-digit display. The colour decoder is a multi-standard one able to handle PAL, Secam, NTSC 3·58 and NTSC 4·43 signals. The panel incorporates a colour transient improvement circuit. Picture geometry is set by remote control and the whole bag of tricks is masterminded by a couple of microcomputer chips interconnected by the I^{2}C bus system used in recent Philips VCRs.

Before you start thinking "the ideal receiver for DX reception" you must realise that the r.f. end of UK versions has only a u.h.f. tuner and that the i.f. gives non switchable 6MHz sound. Nor, at the moment, is a NICAM decoder for stereo sound included. If multi-standard baseband signals are fed in via the scart etc. sockets however they can be processed by the colour decoder.

A precaution has been taken to preserve the initial geometry settings: the user's handset omits the special button needed to put the set into the service mode — more about this later.

I^{2}C Bus for Chip Control

Philips connect the microcomputer chips and the i.c.s they control via a two-track system called the I^{2}C bus. One track carries data, the other clock pulses. The microcomputer chips not only send but also receive data and instructions, so the pulses on the data line may go in either direction. Conflicts are avoided by means of an "arbitration system" which ensures that only one chip at a time transmits data. Errors are avoided by the receiving chip sending back an acknowledge pulse.

Most of this activity is generated by the two microcomputer chips on the control panel. One of these takes care of the tuning and other functions while the other processes the commands from the handset. Doing the work are the computer-controlled teletext chip, the CITAC (computer interface for tuning and analogue control) chip which produces the station tuning voltage and the analogue control outputs, and the geometry control chip which we'll consider later. Fig. 1 shows the configuration of the set of chips used.

The shift register chip on the source selection panel acts as a sort of electronic switchboard that permits handset selection of the off-air signal, the scart socket inputs or the sound and vision phono socket inputs. Switching is not as simple as it sounds since it's necessary to ensure that the correct sound goes with the picture and that whatever is being watched is also routed to the scart socket's output ports to feed any other equipment connected to this.

Basic Layout

The monocarrier/subpanel arrangement used is carried forward from previous models. In the case of the 3A chassis the subpanels are the source selector, the colour decoder, the teletext decoder and the sound output. The timebase and picture geometry circuits are on the monocarrier (you may prefer the more usual term mother board!): the power supply is a version of the now familiar SOPS (self-oscillating power supply) arrangement — see pages 536-7, June 1987.

Audio System

The sound signal is fed to the audio amplifier via a TDA8405 stereo decoder ship which provides stereo/

bilingual sound decoding for the system used in West Germany — this part is disconnected in the UK version apart from one sound detector and the two audio preamplifiers. The two 22W audio output stages feature "anti-plop" circuits which provide sound muting during switching operations. A form of "quasi-stereo" is incorporated. As with previous Matchline models the full sound output is available to matching external loudspeakers, a restricted drive being supplied to the smaller built-in loudspeakers.

Multi-standard Decoding

There are three chips (TDA4555, TDA4565, TDA4580) on the colour decoder panel. The first one, the TDA4555, is a multi-standard decoder. For standards detection it samples the burst (see Fig. 2). Plain 4·43 or 3·58MHz switches it to NTSC, swinging 4·43MHz to PAL and alternate continuous 4·25 and 4·406MHz to Secam. Unlike previous multi-standard decoders, such as that used in the System 4 chassis, this decoder chip is capable of decoding all these different types of colour signal internally — up to now multi-standard decoders have turned other signals into quasi-PAL and processed this as a standard PAL signal. The chip produces demodulated R − Y and B − Y outputs.

The sandcastle pulse from the timebase for gating etc. has three levels. The top of the pulse gates out the burst, the middle bit performs line blanking and a.c.c. gating and the bottom bit provides field blanking. Should the field timebase fail the bottom bit of the sandcastle pulse rises to give total screen blanking, thus preventing screen burn.

Colour Transient Improvement and Crispening

Of greatest interest perhaps is the following TDA4565 chip. This is described as a colour transient improver but it does things to the luminance signal as well. Let's consider briefly what's involved here.

Colour fit has always been a problem with colour sets. The basic cause of the difficulty is the fact that the bandwidth of the chroma channel is about 1MHz while that of the luminance channel is about 5MHz. Because of this the rise time of a colour pulse is around 500nsec while that of the corresponding luminance pulse is only some 100nsec. The effect on the screen would be to make the colour lag behind the luminance by a quarter of an inch (assuming a 22in. c.r.t.). See Fig. 3(a). Hence the inclusion of a luminance delay line in the decoder, to hold the luminance signal back so that the two signals appear to coincide on the screen (even then the coloured edge is a bit smeary). There's more to it than this however. The colour bandwidth with the Continental system B/G is reduced to a lopsided 700kHz due to the proximity of the sound carrier at 5·5MHz — our own broadcasters transmit a colour bandwidth in excess of 1·2MHz (system I). Group delay has an effect too, but you can see from this that a set designed and aligned for Continental transmissions should have either a different delay line from one intended for UK use or the colours displayed in the UK will be unnecessarily scruffy. Up to now this has regrettably been the rule rather than the exception. Now however we have the colour transient improver to provide correction. It works like this.

Fig. 4 shows a simplified block diagram of the processing carried out in the TDA4565 i.c.'s R − Y channel and Fig. 5 the associated waveforms. The R − Y signal is fed to a switched amplifier and to a high-pass filter which detects only high-amplitude colour transients — the one between the green and magenta colour bars is a good example. Waveform A shows such a transient, with poor rise and fall times after passing through the colour decoder circuitry, and waveform B the differentiated output from the high-pass filter. A pulse former is then used to produce squared up pulses, waveform C, which are used as a second input to the switched amplifier. The result of this processing, at the output of the switched amplifier, is the delayed but now squared transient pulse waveform D — the R − Y signal has been smartened up considerably!

The delay with respect to the luminance signal introduced by this processing (and by the other factors previously mentioned) means that a compensating delay line is needed in the luminance channel. Normally the luminance delay line consists of a series of resonant circuits made by winding a thin coil of wire over capacitive patches of metal foil: the solid-state equivalent is the "bucket-brigade" i.c. which passes the signal through one storage stage after another, the delay time being adjusted by the number of stages diffused on the chip. In the TDA4565 however a gyrator circuit is used for the purpose. This is an active filter which reverses the signal phase in one direction but not the other — in other words it behaves inductively. Its parameters can be adjusted by varying the l.t. supply to the circuit.

The TDA4565 has ten gyrator cells each of which provide a delay of 90nsec. Varying the l.t. can alter the number of cells used between seven and ten. In the 3A chassis the l.t. selected is 7·5V which means that nine cells are used, giving a delay time of 9 × 90 = 810nsec. A further "half cell" providing a delay of 45nsec is deployed by connecting pin 13 of the chip to chassis, giving a total delay time of 855nsec. A tap is taken off two cells earlier (180nsec sooner) and this signal is fed to a further feature of the 3A chassis, a discrete component luminance crispener circuit. This detects luminance transients and provides processing in a similar way to the colour circuits. The luminance crispener itself introduces a 180nsec delay, which is why it takes the signal early. It can be switched in and out of circuit via the user's handset. Note that the delay figures quoted are approximate — they vary with different sets/manuals.

Matrixing and Switching

The final chip on the colour decoder panel, the TDA4580, carries out matrixing, switching between the off-air and external RGB signals, blanking, beam limiting and auto grey-scale adjustment. It also provides for colour, contrast and brightness control. Its RGB outputs go to the c.r.t. base panel mounted output stages.

Geometry Setting

The other innovation in the 3A chassis is control of the picture geometry via a remote control handset. Eleven adjustments are provided, including line hold, height, width, field linearity, scan correction, line and field e.h.t. compensation and the EW adjustments. You cannot do this with the user handset. One of the handsets with an inbuilt "print" command is required.

To put the set into the service mode, "print" is pressed while the mono button on the front control panel is held down. A box appears on-screen, with the two left-hand digits indicating the adjustment programmed and the two right-hand digits the adjustment value. For example, press 02 and you can adjust the height, using the handset's

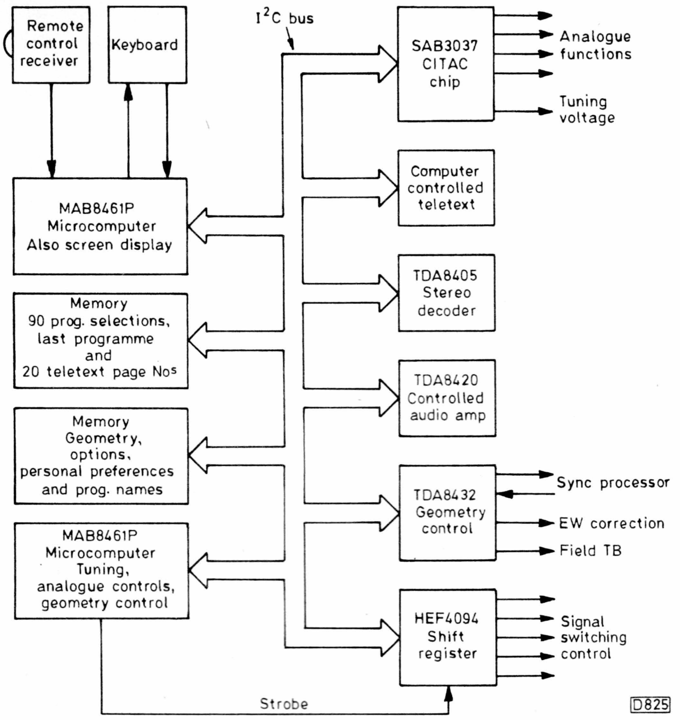
I²C bus
Remote control receiver
Keyboard
SAB3037 CITAC chip
Analogue functions
Tuning voltage
MAB8461P Microcomputer Also screen display
Computer controlled teletext
Memory 90 prog. selections, last programme and 20 teletext page Nos
TDA8405 Stereo decoder
TDA8420 Controlled audio amp
Memory Geometry, options, personal preferences and prog. names
TDA8432 Geometry control
Sync processor
EW correction
Field TB
MAB8461P Microcomputer Tuning, analogue controls, geometry control
HEF4094 Shift register
Signal switching control
Strobe
D825

Fig. 1: Connections via the I²C bus between the two microcomputer chips and the chips they control.

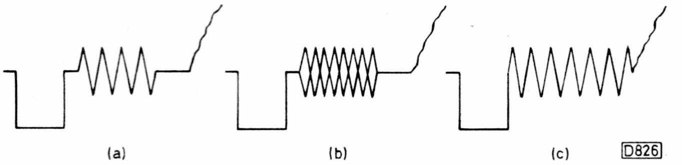

Fig. 2: Multi-standard decoding: identifying the signal. (a) NTSC has a fixed burst at 3·58 or 4·43MHz; (b) PAL has a swinging 4·43MHz burst – the phase shifts on alternate lines; (c) Secam has the back porch alternately full of 4·25 (blue) and 4·406MHz (red) colour subcarrier.

volume control: the left-hand digits will show 02 and the right-hand digits will vary with the volume control's setting. When correct, the setting is stored by pressing the green "granny" button. You then select another adjustment or leave the service mode by going to standby.

This method of control is used in the factory to set up other parameters, so don't try a twiddle. If you think that some hostile element has already done so, enter the service mode, select code 12, and inspect the option code given on the right-hand side of the block. For UK sets this should indicate 32.

Servicing Aspects

The I²C bus system lends itself to built-in test and fault-finding aids. Because there are no two-digit displays with the 3A chassis, fault indications are given by the five LEDs on the control panel — in conjunction with use of the manual. For example, a fault in the computer-controlled teletext decoder will make the crispener and mono LEDs blink, while failure of the 12V supply will blink the crispener and standby LEDs.

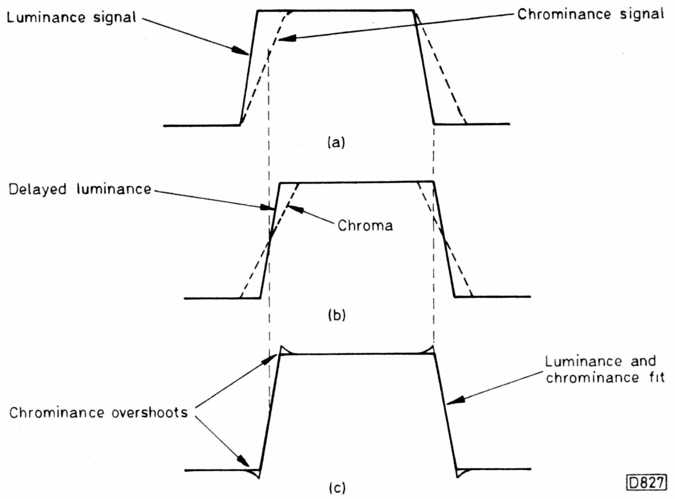
Luminance signal
Chrominance signal
(a)
Delayed luminance
Chroma
(b)
Luminance and chrominance fit
Chrominance overshoots
(c)
D827

Fig. 3: The colour fit problem. (a) The narrow chroma bandwidth has the effect of displacing the colour to the right. (b) By delaying the luminance the two signals fit but the chroma is still diffused at the transients. (c) Colour transient improvement straightens the rise time of high-amplitude chroma transients to give accurate superimposition of the luminance and colour at the screen.

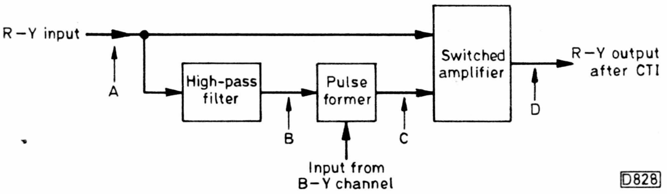
R–Y input
A
High-pass filter
B
Pulse former
C
Input from B–Y channel
Switched amplifier
D
R–Y output after CTI
D828

Fig. 4: Block diagram of the colour transient improvement processing system (R – Y channel).

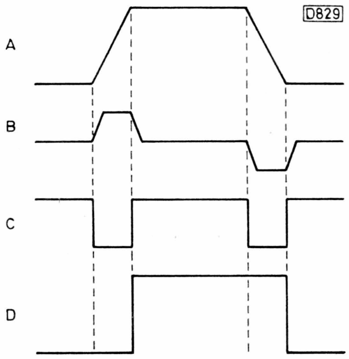

Fig. 5: Waveforms associated with Fig. 4.

The service manual is organised in the same way as with the System 4 chassis, i.e. it has a loose-leaf presentation with subdivisions for the various "works" and separate "cosmetic" sheets that detail the presentation parts and subassemblies used in the various models. All this is available from Philips Service (604 Purley Way, Croydon, Surrey CR9 4DR) to whom the writer is deeply indebted for assistance in the preparation of this article. The Philips Service Technical Survey No. 10 (code 722 17254) covers the 3A chassis in great depth.

Those of you who already have the manual will notice an empty section marked "picture in picture". This feature is incorporated in some overseas versions of the chassis and enables any scart input to be displayed in the corner of the full-screen off-air picture or vice versa. More on this when the feature arrives in UK sets.

Performance

The colour transient improver certainly works. A cleaner transition between green and magenta on a test pattern couldn't be found on a professional colour monitor, and on titling the outlines are much sharper. The crispener is also effective: previous crispener circuits tended to add noise, but this doesn't happen with the arrangement used in the 3A chassis. It's effect is not to everyone's liking however — it's probably unnecessary with system I signals — and if it's used with a VCR that has full HQ circuitry you get a double dose of overshoot. So it's a handset option.

The on-screen display is stable in the absence of an off-air signal, unlike the usual ragged lettering when the background consists of snow. This is due to sync pulses being provided by the teletext sync generator when there's no signal input.

Back in the Groove

Les Lawry-Johns

Yes, we're back in action. Well, nearly. At any rate it's better than living in a cloud all the time.

The Fidelity ZX3000

Now what was it I promised to tell you in the December issue? Oh yes, it was about the Fidelity portable (ZX3000 chassis) that wouldn't start up. It was daft really, and quite simple. I'd been checking the tracks in the chopper circuit from below and had found them to be in order. After several days I checked again, this time from above, i.e. the component side. Two tracks were found to be open-circuit. Stupid, isn't it? And all that time wasted.

Tripler Trouble

A Decca set fitted with the 80 series chassis led me a real dance. I wasn't thinking properly, but managed to discover that the tripler was faulty. Now I could see that it was a single-ended one, and instead of using a universal tripler and reading the instructions I thought I'd save time and fit a Philips G8 tripler. So I clipped off the leads and fitted it quite neatly into the space provided, noting that the e.h.t. lead wasn't quite long enough to reach when the chassis was lowered.

The result was a dark picture, and I found that there was little voltage at the tube's first anodes. A check around the first anode supply network revealed an open-circuit resistor. Time to look at the circuit diagram. It was one of the two resistors connected in series across the first anode potentiometer network. So they shouldn't have prevented the first anodes being supplied if they were faulty. In fact they were both faulty, so I disconnected them and tried again.

This time there was no picture at all. I called the set some nasty names and checked the voltages at the first anodes again. Now the readings were negative. So I hunted around for the first anode supply rectifier diode. There wasn't one, and it began to dawn on me that the new tripler wasn't the right one. This showed me what I didn't know about triplers. I thought that if they didn't have a negative diode lead they were all the same. The Philips tripler was removed, and I then selected a universal type and read the leaflet. Join the diode and earth leads together it said (as for the CVC32). With this fitted I had a nice clear picture and plenty of first anode voltage. I kicked myself for trying to be economic – and more than a little woozy.

G11 on a Hazy Day

Yesterday afternoon I was getting really hazy. It was approaching closing time, so I didn't take another tablet (those tablets to strengthen the heart action and get blood up to the brain – cries of "why doesn't he stand on his head?"). A couple of chaps arrived with this enormous Philips G11, still on its legs. They put it on the bench and I asked what I was supposed to do with it.

"There's no picture and no sound."

I thought I had an h.t. problem, but on switching the set on the tube's heaters lit up and the e.h.t. started hissing away like mad. Having cleared up the hissing I checked the loudspeaker and got a dead short reading, but on checking the audio output transistors I could hear the speaker responding. I checked the RGB output transistors and found that the base and emitter voltages were very low, with the collector voltages rather high. This explained the no picture condition. Why the loss of sound as well?

I made voltage checks and found lots of places where they were very low. I checked the line output panel but the voltages here were correct. By now my mind was completely bunged up. I had to express my regrets and wrap it up. The set was then carted off. After they'd gone I realised that the set was a remote control model, and that the fault must have been in the separate power unit which I hadn't checked. Silly me, but what do you do if you can't think?

The next day I found that the meter had a burnt out resistor in it. This explained the short-circuit reading I got when I checked the loudspeaker. With a new resistor fitted the meter read low-value resistances perfectly. If the owner of the set is reading this, as I suspect he might be, I do apologise. Just check that remote control power supply, will you? The one under the tube, left of centre.

A Glance from Tessa

It was late in the evening. We decided to have a drink before retiring. I looked at the sherry bottle. It contained about three measures, so we dediced to kill it off. After pouring one for myself and one for Honey Bunch I noticed Tess, who was sitting nearby, and was shocked by her appearance. She stared at me in a manner I'd not seen before. Not once did she blink or look away. She just stared. I knew what this meant. I'd to do something she wanted me to do. I drew H.B.'s attention to her.

"Oh, she wants your sherry."

"The drunken bitch."

"No she's not."

So I poured my sherry into a saucer for her. She immediately stopped staring and lapped it up – before I'd a chance to finish pouring out the remainder for myself. More staring. Why didn't she stare at H.B.? I knew I wasn't going to have that sherry and it's funny, when you know you're not going to have something, how you want it far more. I've never been particularly fond of sherry, but at that moment I really wanted that last drop.

I poured most of it into Tessa's saucer, then quickly knocked back the remainder. No more staring – but she did give a few hiccups before going to bed. She snored all night, leaving the guard duty to Zeb. Typical woman . . .

VHS Fast-search Systems

George Cole

The new VHS specification for high-speed index and address search uses CTL (control track) coding. Past indexing systems have relied upon a variety of methods: low-frequency pulses recorded across the full track (the "Automatic Programme Search System"); blank spaces left between recordings ("Auto Scan"); or detection of counter readings (the "go-to" facility). CTL coding works by recording binary code numbers on the control track in the form of specific combinations of zero and one pulses.

In a PAL VHS recorder the control track contains a stream of 25Hz squarewave pulses. Each pulse cycle lasts for 40msec, the pulses being used to synchronise the heads with the video tracks during playback. The normal mark-space ratio is one, i.e. the mark time and the space time are each of 20msec duration. CTL coding involves altering the mark-space ratio to enable binary numbers to be written on to the control pulses.

Fig. 1 shows how this is achieved. A zero pulse is represented by increasing the mark time to 60 ± 5 per cent of the total pulse repetition time, i.e. 24msec, as shown at (a). For a one pulse the mark time is reduced to 27·5 ± 5 per cent of the total time, i.e. 11msec. Because the pulse frequency remains unaltered there's no loss of synchronisation and the system remains compatible with VHS machines that don't use CTL coding.

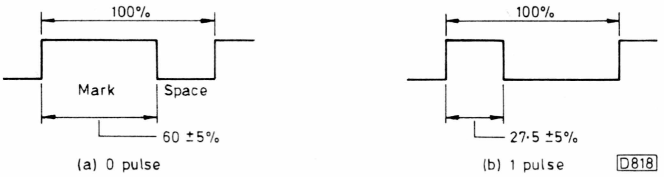

Fig. 1: The pulse code system used. (a) Mark-space ratio representing a zero pulse. (b) One pulse.

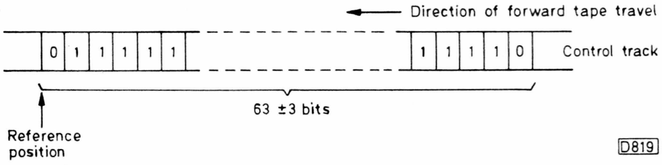

Fig. 2: The index code system.

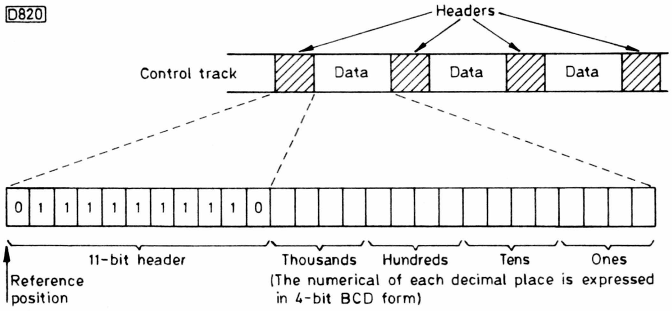

Fig. 3: The address code system.

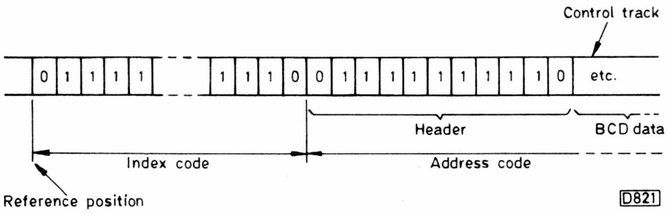

Fig. 4: Use of continuous index and address coding.

There are currently two forms of CTL coding: VHS Index Search System (VISS) and VHS Address Search System (VASS).

Index Search System

VISS is a high-speed index system that allows the user to find specific sections of the tape by means of recorded pulse codes. These codes can be added manually or automatically during the record or playback modes. The index code actually consists of 63 ± 3 bits (see Fig. 2) with a reference marker at the beginning and end to ensure operation in both the forward and reverse modes. The coding time is approximately 2·5 secs (for 625/50 TV systems).

In some machines the index codes are automatically laid down at the beginning of each new recording. With more sophisticated machines the codes can be placed on the tape as required by the user. VISS operates at 40 times the normal playback speed with PAL machines. The codes can be added or erased at will.

Address Search System

VASS makes it possible to record numerical data giving the date, time and counter number at specific locations on the control track. The VCR can thus be programmed to display this information or go to the particular address code number.

To operate VASS the user enters a four-digit address code. Each digit is then converted into a BCD (binary coded decimal) figure, i.e. a four-bit figure. For example, an address code of 3492 would be written on the control track as 0011 0100 1001 0010. Each address consists of an 11-bit header and the four BCD figures, making a total of 27 bits (see Fig. 3) — in practice however the address code is written three times to provide error correction. Another header is placed at the end to ensure operation in the forward and reverse modes. This brings the total bit number to 92 and increases the coding time to around 3·7 secs (625/50 TV systems). The address signal can be changed for renumbering.

Flexibility

CTL coding is a fast, versatile system that offers many advantages over previous indexing systems. The system will operate in the fast forward, rewind and picture search modes, and numerous permutations are possible. VISS and VASS can be combined for example, so that a recording can be quickly found with the recording date instantly displayed (see Fig.4).

Hitachi use CTL coding in their VT410/20/30 machines and have refined VISS so that on pulse detection the VCR displays fifteen seconds of picture search before moving on to the next CTL code. CTL is already appearing in other VCRs, and it probably won't be long before it becomes a standard feature in VHS machines.

HDTV '87

Geoff Lewis, B.A., M.Sc.

A major concern at the May 1986 meeting of the CCIR, held in Dubrovnik, was whether a world-wide standard for high-definition television (HDTV) could be adopted. Delegations from Japan and North America pressed for adoption of the Japanese NHK/Muse system. Its supporters claimed that if no decision was reached NHK/Muse could well become a de facto world standard by default. The major argument for or against such a decision centred on whether a revolutionary or an evolutionary approach to HDTV should be adopted. European delegations preferred an evolutionary approach based on the MAC (multiplexed analogue components) system. But as NHK/Muse was the only HDTV system in even limited commercial use at the time it was widely felt that its acceptance was likely. It's now history that the split actually widened further at the May 1986 meeting, with divisions into 50Hz and 60Hz camps. The session ended with an agreement to disagree and expressions of hope that a common solution could be found at the 1988 or 1990 meetings.

The controversy continued during the International Broadcasting Convention (IBC 86) at Brighton the following September. The Europeans were then being told that the small time window for acceptance of a world standard was closing, and that they were likely to miss the boat again, or words to that effect. With this background, delegates to the HDTV 87 Colloquium in Ottawa would not have been surprised to hear the cry "NTSC (or PAL or Secam) is dead". But not so!

The four-day conference was attended by almost 400 delegates from all around the world and all disciplines and areas of image presentation. There were strong contingents from the TV, cable and film worlds. Nearly forty technical papers were presented and there were continuously running HDTV demonstrations. Particularly useful were the workshops, where small audiences could quiz the experts more closely. The papers presented a wide-ranging view of HDTV, from production through transmission and reception to viewer perception. Psychologists' views were valuable in explaining just what information in an image has to be transmitted and what can be left out while still producing high-definition pictures. Since HDTV requires a wide bandwidth these findings are important in the development of spectrum space saving techniques, a number of which were presented.

Discussion Points

By the end of the first day it was obvious that NTSC is still very much alive, and that it was not only the 50Hz camp that was thinking in terms of evolution. Pointed comments were made about the financial viability of HDTV: a common view was that it would succeed only if introduced with "an already established customer base", implying the need for compatibility with current systems. It appears to be a world-wide fact that the general public is loath to spend more than the equivalent of about £350 on updating its TV or audio systems. A paper from an NHK delegate confirmed that Japan will start an NHK/Muse DBS service in 1990, running in parallel with transmissions using an enhanced NTSC system in order to build upon the present viewer base.

The need for compatibility was questioned several times. The view was put forward that an advanced system warranted a completely new start, without the compatibility burden that's bedevilled television development throughout its history. The short answer to this is that without compatibility HDTV is likely to be a financial disaster.

Is HDTV needed? The fact is that today's display technology is about forty years more advanced than the systems that carry the images: the imperfections of these systems are now clear for all to see.

The next obvious question is who needs HDTV? For a start, cable systems need a good, clean signal. Other early uses would be in medical television, education and the "electronic cinema". The cost of any new service has to be borne by the end user of course: this implies the need to advertise and market HDTV vigorously in order to increase public awareness of the prospects.

After the conference the public in six North American cities was treated to two weeks of demonstrations, the aim being to acquire statistical data that would enable the demand for HDTV to be assessed.

Proposals and Demonstrations

Although the NHK/Muse system had a very high profile throughout the conference, both in papers and demonstrations, many other possible ways of implementing HDTV were presented. The simple approach of changing from interlaced to sequential scanning, which significantly improves the vertical resolution at the cost of increased bandwidth, formed the basis of some ingenious proposals. The use of digital processing to double the line rate was also put forward in some presentations.

A particularly impressive development was demonstrated by the David Sarnoff Research Centre Laboratory (GE/RCA/NBC). This multiplexed into a standard 6MHz channel enough additional information on subcarriers to double the line rate, vastly improve the vertical resolution, change to progressive scanning, avoid flicker, line and dot crawl and still be compatible with a standard NTSC receiver. For direct comparison the demonstration included a wide-screen (16:9 aspect ratio) receiver and a standard NTSC receiver working side by side. The system shown in this way achieved a vertical resolution of more than 420 lines: it was stated that with a greater bandwidth this could be extended to about 750 lines, making it comparable with NHK/Muse.

The North American Philips Corporation had previously demonstrated another NTSC compatible approach to HDTV. This work was described in two papers. The two-tier HDMAC-60 system is designed to provide over a satellite link high quality signals suitable for retransmission or use as a cable system feed. It involves a complex MAC time-compression/expansion process to ensure that all the signal components are contained within a bandwidth of about 9MHz. HDMAC-60 signals can be displayed on special high-definition receivers or transcoded for distribution via a high-definition NTSC network. The 9MHz bandwidth occupies two cable channels: one carries the standard NTSC signal while the second carries the resolution extension components which would provide a resolution in excess of 480 lines.

These compatible developments remind one of the E-PAL system that was devised by the BBC back in 1981/2.

Maybe this concept is also worth further investigation.

The B-MAC system was demonstrated in two compatible forms. One, WIDE-MAC, has a 16:9 aspect ratio with 525 lines. The other, HDB-MAC, uses a line interpolation technique to double the line rate. Both displays were free of the imperfections common to present systems while the second format gave a very high resolution as well.

Three papers put forward the European commitment to D-MAC. The paper from an IBA delegate gave the following time-scale for possible introduction of HDTV in the UK. Phase one, from 1989-1992, would see the introduction of D-MAC for use with standard PAL receivers via a set-top convertor. Phase two, 1990-2000+, would see the introduction of integrated MAC/PAL receivers costing around £450. Phase three, 1991-2000+, would see the introduction of a wide-screen service with 16:9 aspect ratio, compatible with Phase one and two operations: wide-screen receivers would cost around £1,000. Phase four, 1995-2000+, would see the introduction of the HD-MAC format with 1,250 lines, 50 fields per second and 2:1 interlacing, still compatible with the earlier stages: receivers would not cost less than £1,500.

The paper from a British Telecom Research Laboratory (BTRL) representative, though not strictly relating to HDTV, covered the D2-SMAC system that BTRL has developed as an aid to spectrum space saving. By using a subsampling process (the S in SMAC) the system discards alternate video samples before transmission: controlled interpolation is used in the receiver to replace the missing samples. The aim of this new MAC variant is to enable four MAC channels to be transmitted over each 36MHz satellite transponder instead of two.

Assessing NHK/Muse

Some very impressive demonstrations of the NHK/Muse system were given – over satellite links, via a cable network, and with a laser scanned video disc. For display, wide-screen receivers, a 50in. rear-projection set and a 16 × 9ft projection system were used, giving delegates plenty of opportunity to evaluate the system quality subjectively.

There are now two variants of NHK/Muse. Muse-T has a base bandwidth of 16·2MHz and requires a full 54MHz transponder bandwidth. It has been developed for satellite signals intended for redistribution. Muse-E is intended for direct satellite reception. It has a base bandwidth of only 8·1MHz and can be handled by half a transponder. The satellite/cable demonstration using Muse-E for the satellite link and 6km of the Ottawa cable system was most impressive, though it used four cable TV channels in the process.

The NHK-Muse system has been demonstrated so many times that subjective assessment of quality can now be made. Without denying the brilliance of the concept, the system nevertheless does have its imperfections. When the carrier-noise ratio falls to about 5-6dB below the designed for level false colours become apparent – in fact the choice of chrominance components was called into question. A strobing effect or blurring can be seen in picture areas where there are diagonal stripes or where diagonal movement occurs. A change of signal level produces some loss of resolution in picture areas where there is movement. No doubt further development will resolve these defects.

One or more Standards?

Whether a single world-wide standard for HDTV is desirable in itself is a question that needs to be considered. Would the VHS and Beta VCR systems provide the high-quality displays they now do had there been a single world-wide standard? Probably not – the drive for market dominance has undoubtedly led to improved performance. So two HDTV standards might in the long term be the best solution, especially if a common conversion standard is available to ensure wide distribution of the world's TV programmes.

Correction

The phased array computer program published in the January issue was incorrect in two respects. First, lines 530 to 1000 were omitted – these lines draw the aerials on the screen, and are listed below. Secondly "FOR H=8 to 9" in line 110 should have read "FOR H=8 TO 9".

```
 530 DRAW 600,600
 540 MOVE 400,700
 550 DRAW 600,700
 560 MOVE 400,800
 570 DRAW 600,800
 580 MOVE 400,900
 590 DRAW 600,900
 600 ENDPROC
 610 DEF PROC_Angle
 620 MOVE 500,400
 630 DRAW 1200,800
 640 PRINT TAB(32,3);"Unwanted"
 650 PRINT TAB(33,5);"Signal"
 660 PRINT TAB(16,17);CHR$(224)
 670 ENDPROC
 680 DEF PROC_Antenna_2
 690 MOVE 900,400
 700 DRAW 900,900
 710 MOVE 800,400
 720 DRAW 1000,400
 730 MOVE 800,500
 740 DRAW 1000,500
 750 DRAW 1000,520
 760 DRAW 800,520
 770 DRAW 800,500
 780 MOVE 800,600
 790 DRAW 1000,600
 800 MOVE 800,700
 810 DRAW 1000,700
 820 MOVE 800,800
 830 DRAW 1000,800
 840 MOVE 800,900
 850 DRAW 1000,900
 860 ENDPROC
 870 DEF PROC_Result
 880 MOVE 900,350
 890 DRAW 900,200
 900 MOVE 500,350
 910 DRAW 500,200
 920 COLOUR 1
 930 PRINT TAB(15,1);"To Transmitter"
 940 PRINT TAB(16,23);<——————————>"
 950 PRINT TAB(20,25);Dist;"cm"
 960 PRINT TAB(0,6);CHR$(224);"= ";Deg;"deg"
 970 PRINT TAB(0,8);"CHANNEL ";Chan
 980 PRINT TAB(0,10);N;"MHz"
 990 PRINT TAB(5,27);"Space the aerials "Dist;"cm apart"
1000 ENDPROC
```

Service Bureau

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AMSTRAD CTV2200

This set switches on normally, works perfectly for half an hour, then shuts down. Normal operation is restored if the on/off switch is used after a few seconds. The set then shuts down again after a shorter period. The same sequence of events occurs, with the set working for progressively shorter periods. We have replaced the chopper transistor Q501, its driver Q502 and the control chip IC501, and have remade all suspect joints. In the shut down condition there is 325V at the collector of Q501 which seems to be without drive. Removing the c.r.t. base or reducing the picture size by turning down the 153V adjustment potentiometer VR501 gives continuous working.

The fact that removing the tube base or reducing the h.t. voltage clears the fault suggests that the protection circuit is coming into operation. In our experience the e.h.t. section of the diode-split line output transformer T802 can cause this sort of trouble, but before condemning it check the current monitoring devices R526, Q503, etc. Overload shutdown occurs when pin 5 of IC501 rises from zero volts.

FERGUSON 3V01

The problem is no take-up. A new take-up assembly was fitted, also a new tyre on the take-up spool, but there's still no take-up. The loading mechanism moves the idler almost into position but the take-up idler isn't actually touching the take-up spool tyre – there's little space between the two. Nor is the pressure roller touching the capstan. The impedance rollers aren't rolling either.

First make sure that the tape loading is complete and that the after-load switch S6 is being operated correctly. If so, concentrate on the action of the pinch roller solenoid. Confirm by manually closing it fully that take-up begins and that there's no obstruction or excessive friction, i.e. old, hard grease. If not suspect the solenoid itself – once you've confirmed that X6/7 in the solenoid drive circuit are turning on fully, indicated by less than 1V at pin 13 of the mechacon panel.

CIHAN 1224

The problem with this 12in. monochrome portable is weak sync. Both the line and field have to be adjusted each time the set is switched on, and any change in picture content will make the field roll out of control. The picture is otherwise very good. The voltages around the sync separator seem to be o.k. and replacing the transistor has made no difference.

The crucial factor in these simple sync separator circuits is the transistor's base bias. We suggest you replace the base circuit resistors and if necessary the input coupling capacitor. If this doesn't cure the problem an oscilloscope will be required to check the progress of the video waveform to the sync separator and the separated sync pulse output. These sets were imported by Network Industries Ltd.

SHARP VC7700

The only way in which this machine will turn off is to use the switch at the back. At all other times the cassette lamp stays on and the head drum continues to rotate.

The problem is due to the fact that the tape is not fully unlaced – or the machine thinks it's not fully unlaced due to failure of the unload end switch SW01. If the tape guides have not retracted fully, check the loading mechanics starting with the loading motor belt.

FERGUSON TX10 CHASSIS

This set is fitted with the PC1561 signals board. The problem we have is distortion on sharp sounds – for example when money is thrown into a till or when a paper bag is crumpled.

Very often careful adjustment of the sound detector coil L561 will clear this type of distortion. Don't turn the ferrite core more than about half a turn either way.

SHARP VC7300

On stop from rewind there's a tendency for a length of slack tape to be left. We've encountered this problem several times with this model. Previously, replacement of the unloading and rewind belts eased or cured the problem, but not this time. I'm aware of the momentary "nudge" when eject is initiated, but the amount of slack is well outside the scope of this operation.

The key to the problem is what you call the "nudge" when eject is initiated. In all such cases we've encountered replacement of the loading block assembly has cured the problem.

SONY KV2056UB

At switch on there's a short hum then nothing at all. I've drawn a blank after making various static tests, though dummy loading the power supply suggests that the fault is not in the line timebase.

Despite your dummy load test, start by making an ohmmeter test across the line output transistor Q503. If a short-circuit or low resistance reading is found, isolate for test Q503, D507, D508 and D613. If the resistance across the h.t. line is correct, concentrate on the power supply, checking Q602 and *all* the diodes out of circuit with an ohmmeter. If they prove to be o.k., check R602, R609 and R610 before suspecting the TDA4600 chopper control chip IC601.

GRUNDIG GSC200 CHASSIS

This set works very well except that the sound will suddenly go off and the picture become grainy, as if the aerial is disconnected. If the tuning module is tapped everything returns to normal. I've hard wired some of the connections between the tuning module and the mother board but the problem remains.

There's no doubt that a dry-joint is present in the tuning module. While we've had this situation from time to time we've not found any one joint to be commonly responsible. A close examination of the print and the soldered connections should reveal the cause of the problem – if necessary use a magnifying glass. If nothing can be seen, get the module connected and operating then gently flex and probe it with a suitable tool to locate the trouble spot.

TEST CASE

302

Each month we provide an interesting case of TV/video servicing to exercise your ingenuity. These are not trick questions but are based on actual practical faults.

A difficult decision for service departments these days concerns how much work can practically be carried out in the field and at what point an outside technician should call a halt and bring the set into the workshop for diagnosis and repair. Much depends on the nature of the fault and the design of the set – and, of course, on the ability of the man on the spot. The problem can sometimes be solved by a quick telephone call to a more experienced bench technician, and we find ourselves resorting to this "consult the oracle" method more and more lately. Hence this month's test case, which concerns a field technician who was not as familiar as he might be with fault finding but is learning fast.

He'd been sent to see a 16in. ITT set in a house some miles from base. The problem reported was "bright screen with lines across", about as specific a fault description as one could hope to get from a non-technical customer. Advised in advance to start by checking the c.r.t.'s cathode voltages, our technician was nonplussed to find on arrival that the picture was good. It was bright, as it should be, and it had lines across – 600-odd scanning lines that traced out a beautiful colour picture. The owner confidently predicted that the fault would perk up within a few minutes, and sure enough it did. The screen suddenly brightened up, with a prominent display of field flyback lines.

By the time the technician had got out the service manual and circuit diagram (ITT CVC40 chassis) the symptom was well established. Suspecting that the tube's cathode voltages were incorrect, our man made his first meter checks here. The circuit diagram told him that for a normal picture 90-135V was to be expected. The readings obtained were somewhat higher, around 150V. This was odd: one would expect an increase in cathode voltage to darken the screen, not light it up. It was reasoned that the cathode voltage is relevant only in relation to the grid voltage, so the tube's grid voltage (pin 9) was next checked. It was found to be about 20V, which was reasonable from an inspection of the resistor values used in the potential divider network that provides the supply.

How about the first anode voltage? Adjustment of the first anode voltage control potentiometer R47A on the mother board made little difference to the display on the screen, so trouble here was discounted. In fact it seemed that the tube itself was faulty, since an increase in the cathode voltage appeared to have led to an increase in brightness and a virtual loss of picture information.

On to the land-line then and dial the secret workshop number that rings the phone beside the workbench of a friendly and knowledgeable soul – Sage himself. In fact Sage was a bit short-tempered, having just had a ding-dong with a customer who'd demanded a new tuner for his VCR free of charge on the basis of having had his cassette lamp replaced six months previously.

When the field technician described his troubles Sage became even more short-tempered! He was able to diagnose the fault with certainty, and to say it was very unlikely that the exact component required would be available in the mobile spares stock. It could be made with a combination of two other parts however. What was it? See next month.

ANSWER TO TEST CASE 301

– page 208 last month –

January's test case, while relating to a Sony camcorder, was really about the wider issue of sussing out fault areas by careful observation of the symptoms and the behaviour of the equipment. Emergency shut-down took place within a few seconds of selecting a mode in which the tape moved, i.e. one involving the rotation of the spools at the very least. In this particular machine the reels are driven from the capstan motor, but the same rules of diagnosis apply where the VCR's reel tables have their own drive arrangements.

These shut-down situations nearly always have their origin in the deck sensors – the cassette lamp, loading switches, rotation sensors, slack and dew detectors and so on. In this case several of these were exonerated by the readiness of the machine to start, to thread the tape and to respond initially to keyed-in commands. In view of the fact that the machine would work in play pause, when the reel rotation sensors are inactive, it seemed almost certain that the problem was in the reel sensor circuit – and so it proved to be.

In this machine the outputs from the reel sensors – two under the take-up reel and one under the supply reel – are detected by a strobe-pulse system based on the mechacon microcomputer. There was no need for the scope however – two of the sensor optocouplers were dry-jointed to the PCB!

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TELEVISION FEBRUARY 1988

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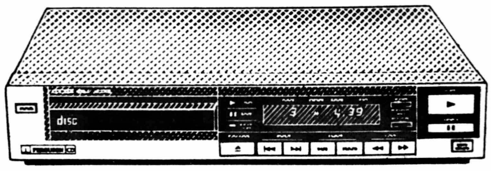

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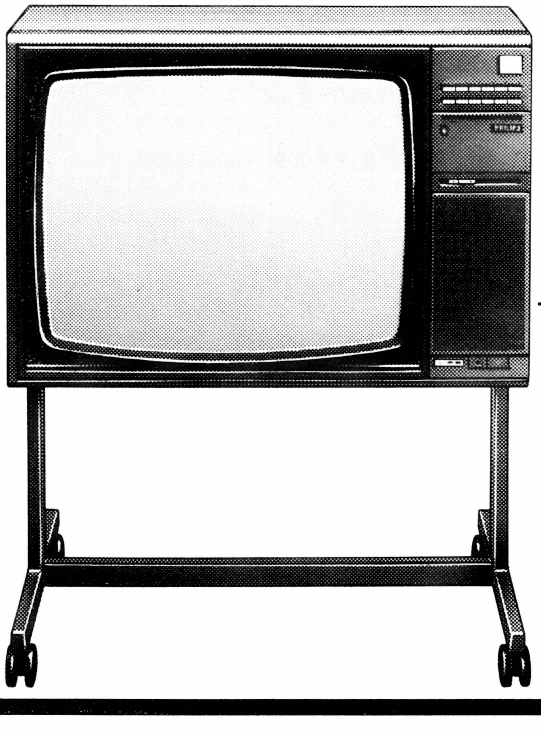

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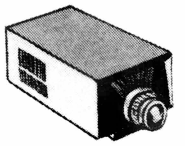

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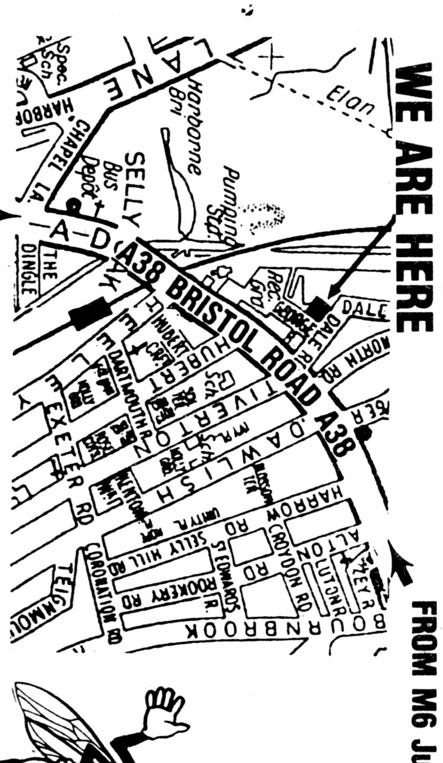

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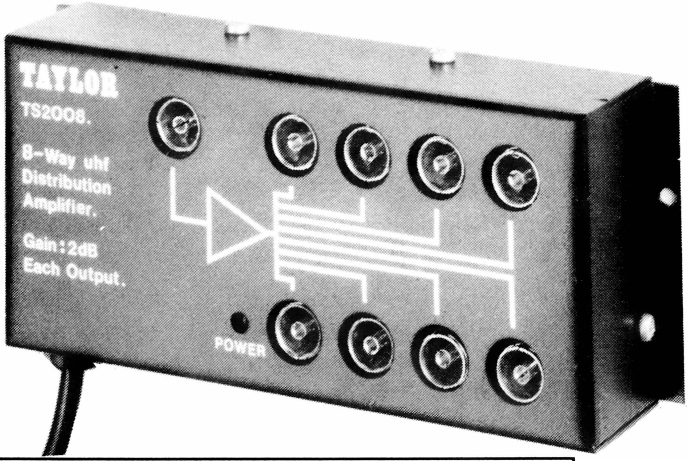
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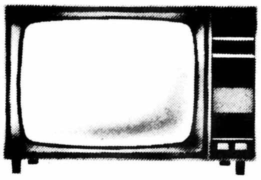

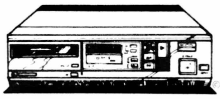

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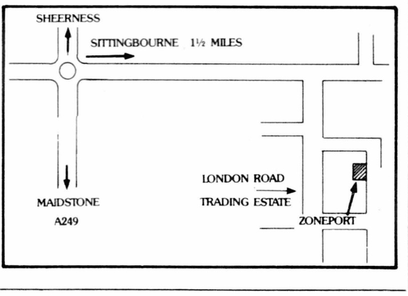
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VP25	10	Mixed shape and colour LED's	£1.00
VP26	15	Small .125" Red LED's	£1.00
VP27	15	Large .2" Red LED's	£1.00
VP28	10	Rectangular .2" Red LED's	£1.00
VP57	25	Opto Special Pack. Assorted, super value	£3.00
VP130	6	RED 7 Seg. CC 14mm x 7.5mm RDP FND353 LED Display	£2.00
VP131	4	GREEN 7 Seg. CA .6" LDP XAN6520 LED Display	£2.00
VP133	6	RED Overflow .6" 3 x CA 3 x CC 6630/50 LED Display	£2.00
VP134	5	GREEN Overflow .6" CA XAN6530 LED Display	£2.00
VP138	20	Assorted LED Displays. Our mix, with data	£5.00
VP147	1	Pair Opto Coupled Modules	£0.60
VP199	4	LD707R LED Displays, CA	£1.00
VP203	15	Triangular shape LED's, mixed colours	£1.00
VP204	10	Large Green LED's, 5mm	£1.00
VP205	10	Small Green LED's, 3mm	£1.00
VP206	10	Large Yellow LED's, 5mm	£1.00
VP207	10	Small Yellow LED's, 3mm	£1.00
VP208	10	Large LED's clear showing Red, .2"	£1.00
VP241	2	ORP12 Light Dependant Resistor	£1.50
VP242	3	Tri-colour LED's, 5mm dia., 5mA 2v, R.G.Y	£1.00
VP243	3	Tri-colour LED's, Rectangular 5mm, R.G.Y	£1.00
VP266	10	Orange LED's, 5mm large	£1.00
VP267	8	Stackable LED's. Rectangular, mixed, R.G.Y	£1.00
VP268	15	LED Panel Mounting Clips, metal and plastic. 3-5mm	£1.00
VP269	2	Red Flashing LED's, 5mm	£1.00
VP284	2	Opto-Isolator IL74-4N27, single	£1.00
VP285	1	Dual Opton-Isolator ILD74	£1.00

Pak No	Qty	Description	Price
		TRANSISTORS.	
VP172	10	SM1502 PNP TO-39 Sil. Transistors, 100v 100mA Hfe100+	£1.00
VP200	30	OC71 type germanium AF Transistors, uncoded	£1.00
VP201	25	OC45 germanium RF Transistors	£1.00
VP261	4	Programmable Unijunction Transistors, MEU22	£1.00
VP270	10	FET's UHF/VHF Amplifiers, switching & choppers, data	£1.00
VP271	10	FET's general purpose like 2N3819-2N5457, data	£1.00
VP272	10	MOS-FET's Signetics, SD304	£1.00
VP280	12	ZTX300 NPN Silicon Transistors	£1.00
VP290	15	MPSA06 Sil. Transistors. NPN 80v 500ma Hfe50+ TO92	£1.00
VP428	10	AC128K PNP Germanium Transistors, 1A 32v	£1.00
VP429	10	AC176K NPN Germanium Transistors, 1A 32v	£1.00
VP430	4	2N3055 Sil. Power Transistors, full spec	£2.00
VP431	25	PNP Sil. Transistors, TO-39 like 2N2905A	£1.00
		I.C.S	
VP40	40	TTL I.C.S all new gates – Flip Flop – MSI, data	£4.00
VP54	20	Assorted I.C. DIL Sockets, 8-40 pin	£2.50
VP59	20	Assorted I.C.s linear, etc, all coded	£2.00
VP209	12	74LS00	£2.00
VP210	12	74LS74	£2.00
VP211	10	CD4001B	£2.00
VP212	10	CD4011B	£2.00
VP214	10	CD4069B	£2.00
VP215	10	741P 8 pin	£2.00
VP216	10	555 Timers 8 pin	£2.00
VP223	50	Asst 74 TTL I.C.s. "ALL GATES" new & coded our mix 7400-7453	£6.00
VP224	100	Asst 74 TTL I.C.s "ALL GATES" new & coded our mix 7400-7453	£10.00
VP282	1	Prog. Sound Gen. Chip. AY-3-8912	£3.00
VP291	1	Z80ACPU Microprocessor. 40 pin DIL	£2.00
VP292	1	Z80AP10 Parallel Interface Controller, 40 pin DIL	£2.00
VP293	1	Z80ACTC Counter Timer Circuit, 28 pin DIL	£2.00
VP294	1	2732D 32K Eprom	£3.00
VP295	1	6821P Peripheral Interface Adaptor (PIA)	£1.50
VP296	6	LM324 14 pin DIL Quad Op-Amp	£2.00
VP297	5	CA3130E MOS-FET I/P, CMOS O/P, Op-Amp	£2.00
VP298	3	MC1310P Stereo Decoder, 14 pin DIL	£2.00
VP299	3	CA3085 Pos. Volt. Regulator, 1.7v-46v, 8 pin TO5	£2.00
VP400	1	27128 128K Eprom	£2.50
VP401	2	LM317T Adjst, Voltage Regulator, 1.5A	£1.00
VP402	1	2114 4K Static Ram	£2.00
VP403	1	TA7204 Audio Amp I.C. 4.2w, 13v, 2-4 ohms	£1.00
VP404	1	TBA461 Audio Power Amp, 4.5w	£1.50
VP432	8	CD4016B	£2.00
VP433	6	CD4017B	£2.00
VP434	10	CD4024B	£2.00
VP435	10	CD4028B	£2.00
VP7413	4	7413 Dual Nand Schmitt Trigger, 4-input	£1.00
VP7440	4	7440 Dual 4-input, Positive-Nand Buffer	£1.00
VP7470	4	And-gated Positive-edge-triggered Flip-Flop with preset	£1.00
VP7480	4	7480 Gated full Adder	£1.00
VP7481	4	7481 16-bit Random Access memories	£1.00
VP7490	4	7490 Decade Counter	£1.00
VP7491	4	7491 8-Bit Shift Register	£1.00

Pak No	Qty	Description	Price
		MISC.	
VP177	1	Pack assorted Hardware, nuts, bolts, etc	£1.00
VP178	5	Assorted Battery Holders and Clips, PP3/9, AA/D, etc	£1.00
VP223A	6	Tag Boards, 18 way paxaline	£1.00
VP225	20	DIN Plugs, plastic 2-8 pin, 180°/240°/360° mixed	£2.50
VP226	20	DIN Chassis Skts, metal 2-8 pin 180°/240°/360° mixed	£2.50
VP227	18	DIN In-line Skts, plastic, 2-8 pin 180°/240°/360° mixed	£2.50
VP228	10	C15 Computer Cassette Tapes. leadless	£3.00
VP232	1	Cassette Head Cleaner/Demagnetizer, in case	£2.00
VP233	1	Revolving Cassette Rack, holds 32, smokey perspex	£2.50
VP244	1	High Power Piezo Electric Siren. Emits earpiercing warbling sound. Ideal alarm. White plastic body with mounting bracket. Power 12vDC 150mA. Output 100dB (A) at 1m typ. freq. 2.5KHz. Size: 57 x 42 x 37mm	£6.00
VP260	1	9" x 6" Elliptical 8 ohms 10W RMS Speaker. Freq. Res. 60-10000 Hz. Gauss 10000. Centre HF cone	£4.50
VP260A	1	2 1/4" Transducer Waterproof Speaker. Polyester film diaphragm. Moisture res. 8 ohms 300mW Freq. Res. 20-20000 Hz	£1.00
VP273	10	10K Lin Rotary Potentiometers, slim spindle	£1.00
VP281	4	Plug-in Relays. Mixed volts, etc	£1.00
		TOOLS.	
VP95	1	Plastic Vice, small, with suction base	£1.75
VP97	1	Logic Probe/Tester, supply 4.5v-18v, DTL, TTL, CMOS	£8.50
VP99	1	Universal Tester, with ceramic buzzer	£5.00
VP103	1	6 Pc STANLEY Screwdriver Set. Flat and crosspoint	£3.50
VP139	1	Pick-up Tool, spring loaded	£1.75
VP217	1	Helping Hand	£4.00
VP218	1	Watchmakers Screwdriver Set, 6 pieces	£1.75
VP219	1	Miniature Side Cutters	£1.55
VP220	1	Miniature Bent-nose Pliers	£1.55
VP221	1	Miniature Long-nose Pliers	£1.55
VP237	1	Universal Ni-Cad Battery Charger. AA-HP11-HP2-PHP3	£6.00
VP238	4	AA Ni-Cad Batteries. 1.25v 500mAH C/R mA	£4.00
VP239	2	C-HP11 Ni-Cad Batteries. Rechargeable	£3.50
VP240	2	D-HP2 Ni-Cad Batteries. Rechargeable	£4.00
VP246	1	25w Quality Low Cost Soldering Iron. 240vAC	£3.50
VP247	1	15w "Lightweight" Quality Low Cost Soldering Iron. 240vAC	£3.50
VP248	1	High Suction Desoldering Pump. Teflon nozzle. Auto eject. heavy duty return spring	£4.00
VP250	1	Long Finger Grip. Soldering aid. Heavy metal base. Serrated jaws with rev. tweezer action. Ideal for holding small components. Fully adjustable	£3.00
VP254	1	250 grams Etchant Granules (Ferric Chloride) makes 1/2 pint	£1.00
VP255	1	Etching Pen. Etch resistant. Spare tip. Blue	£1.00
VP258	1	Multicore Solder. 5m total. 10 and 22 SWG	£1.00
VP259	1	PCB Holder. Fully adjustable from 0-320mm wide and to any angle. Complete with iron stand and sponge. Strong metal construction with rubber feet. Very high quality	£15.00
VP286	2	Etch Resist PCB Transfer Sheets. Asst. symbols/lines	£1.00
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VP406	1	Junior Hacksaw & 3 blades + hobby knife & 2 blades	£1.00
VP407	1	10 Piece Needle File Set	£3.00
VP408	1	4 Piece Stainless Steel Tweezer Set	£4.00
VP409	1	Set of 4 min. low cost Side & End Cutters, snipe & combination Pliers. 5" insul. handles	£4.50

Pak No	Qty	Description	Price
		DIODES & SCRS.	
VP29	30	Assorted volt Zeners. 50mw-2w	£1.00
VP30	10	Assorted volt Zeners. 10w, coded	£1.00
VP31	10	5A SCR's TO66, 50-400v, coded	£1.00
VP32	20	3A SCR's TO66, up to 400v, uncoded	£1.00
VP33	100	Sil. Diodes like IN4148	£1.00
VP34	200	Sil. Diodes like OA200/BAX13-16, 40v 200mA	£1.00
VP35	50	1A IN4000 Diodes, all good, uncoded, 50v min	£1.00
VP49	30	Assorted Sil. Rectifiers 1A-10A, mixed volt	£1.00
VP141	40	IN4002 Sil. Rectifiers, 1A 100v, preformed pitch	£1.00
VP142	4	40A Power Rectifiers, silicon, TO48 300 PIV	£1.00
VP143	5	BY187 12KV Sil. Diodes, in carriers, 2.5MA	£1.00
VP184	3	4A 400v Triacs, plastic	£1.00
VP187	10	SCR's 800MA, 200v, 2N5064, plastic, TO92	£1.00
VP194	50	OA91 point contact germanium Diodes, uncoded	£1.00
VP195	50	OA47 gold bonded germanium Diodes, uncoded	£1.00
VP196	50	OA70-79 detector germanium Diodes	£1.00
VP197	50	OA90 type germanium Diodes, uncoded	£1.00
VP198	40	BA248 Sil. Diodes, 350v 2A, fast recovery	£1.00
VP222	20	3A Stud Rectifiers, 50-400v, assorted	£1.00
VP274	12	SCR's (Thyristors) 1A 100-400v, TO-39	£1.00
VP275	3	5A 400v SCR's, TO220, TIC106D	£1.00
VP276	5	SCR's standard type, 5-16Amp to 400v	£1.00
VP277	4	Triacs 2Amp 400v TO-39	£1.00
VP278	4	6Amp 1000v plastic Silicon Rectifiers	£1.00
VP283	5	Diac BR100, triac trigger	£1.00
		TRANSISTORS	
VP38	100	Sil. Transistors, NPN plastic, coded, with data	£3.00
VP39	100	Sil. Transistors, PNP plastic, coded, with data	£3.00
VP47	10	Sil. Power Transistors, similar 2N3055, uncoded	£1.00
VP48	5	Pairs NPN/PNP plastic Power Transistors, 4A, data	£1.00
VP50	60	NPN Sil. Switching Transistors, TO-18 and TO-92	£1.00
VP51	60	PNP Sil. Switching Transistors, TO-18 and TO-92	£1.00
VP60	100	All sorts Transistors, NPN/PNP	£1.00
VP150	20	BC183B Sil. Transistors, NPN 30v 200mA Hfe240+ TO92	£1.00
VP151	25	BC171B Sil. Transistors, NPN 45v 100mA Hfe240+ TO92	£1.00
VP152	15	TIS90 Sil. Transistors, NPN 40v 400mA Hfe100+ TO92	£1.00
VP153	15	TIS91 Sil. Transistors, PNP 40v 400mA Hfe100+ TO92	£1.00
VP154	15	MPSA56 Sil. Transistors, PNP 80v 800mA Hfe50+ TO92	£1.00
VP155	20	BF595 Sil. Transistors, NPN eqvt BF184 H.F. TO92	£1.00
VP156	20	BF495 Sil. Transistors, NPN eqvt BF173 H.F. TO92	£1.00
VP157	15	ZTX500 series Sil. Transistors, PNP plastic	£1.00
VP158	15	ZTX107 Sil. Transistors, NPN eqvt BC107 plastic	£1.00
VP159	15	ZTX108 Sil. Transistors, NPN eqvt BC108 plastic	£1.00
VP161	25	BC183L Sil. Transistors, NPN 30v 200mA TO92	£1.00
VP162	5	SJE5451 Sil. Power Transistors, NPN 80v 4A Hfe20+	£1.00
VP163	2	NPN/PNP pairs, Sil. Power Transistors, like SJE5451	£1.00
VP164	4	2N6289 Sil. Power Transistors, NPN 40v 40w 7A Hfe30+	£1.00
VP165	6	BFT33 NPN Sil. Transistors, 80v 5A Hfe50-200 TO39	£1.00
VP166	5	BFT34 NPN Sil. Transistors, 100v 5A Hfe50-200 TO39	£1.00
VP167	1	BUY69C NPN Transistors, TO3 VCB 500, 10A, 100w, Hfe15+	£1.00
VP168	10	BC478 eqvt BCY71 PNP Sil. Transistors. TO18	£1.00
VP169	10	BXS21 eqvt BC394 NPN Sil. Transistors, 80v 50mA TO18	£1.00
VP170	10	Assorted Power Transistors, NPN/PNP coded and data	£1.00
VP171	10	BF355 NPN TO-39 Sil. Transistors, eqvt BF258 225v 100mA	£1.00

Pak No	Qty	Description	Price
		I.C.S.	
VP7492	4	7492 Divide by 12 Counter	£1.00
VP7493	4	7493 4-bit Binary Counter	£1.00
VP7494	4	7494 4-bit Shift Register	£1.00
VP7495	4	7495 4-bit Shift Register	£1.00
VP74111	4	74111 Dual J-K Master Slave, Flip-Flop	£1.00
VP74141	4	74141 BCD-Decimal Decoder/Driver	£1.00
VP74151	4	74151 1 of 8 Data Selectors/Multiplexers	£1.00
VP74153	4	74153 Dual 4 line to 1 line Data Selectors/Multiplexers	£1.00
VP74164	4	74164 8-bit Parallel Output Serial Shift Registers	£1.00
VP74167	4	74167 Synchronous Decade Rate Multipliers	£1.00
VP74174	4	74174 Hex D type Flip-Flops	£1.00
VP74181	4	74181 Arithmetic Logic Units/Function Generators	£1.00
VP74193	4	74193 Synchronous Up/Down Dual Clock Counters. Binary clear	£1.00
VP74279	4	74279 Quad S-R Latches	£1.00
BPX6	1	TTL Data Book 74 series, including "LS". Complete with Pin out diagrams. 7400-74670. TT1 interchangeability guide. Function selection guide and explanation of function tables. "NO VAT"	£1.00
BPX5	1	IC555 PROJECTS BOOK (TIMER). 167 pages. Over 50 project circuits to build and other information on IC555 Timers. Plus FREE with our compliments, 3 x IC 555 Timer, worth 80p. **Special offer price just £2.95. "NO VAT"**	
BPX4	1	INTERNATIONAL TRANSISTOR EQUIVALENTS GUIDE, Babani Publishing's latest edition BP85, plus FREE with our compliments, 10 popular Silicon Transistors, worth £1.00. **Special offer price just £3.50. "NO VAT"**	
		MISC.	
VP17	50	Metres PVC single strand Wire, mixed colours	£1.00
VP18	30	Metres PVC multi strand Wire, mixed colours	£1.00
VP19	40	Metres PVC single/Multi strand Wire, mixed colours	£1.00
VP22	200	Sq. Inches total Copper Clad Board	£1.00
VP23	10	40mm Track Slider Pots. 100K Lin	£1.00
VP42	10	Black Heatsinks, fit TO3 and TO220, drilled	£1.00
VP43	4	Power-fin Heatsinks, 2 x TO3, 2 x TO66	£1.00
VP44	15	Assorted Heatsinks, TO1/3/5/18/220	£1.00
VP56	100	Semiconductors from around the world, mixed	£4.00
VP82	1	Electronic Buzzer, 3v, 25MA	£0.95
VP83	1	Electronic Buzzer, 6v, 25MA	£0.95
VP84	1	Electronic Buzzer, 9v, 25MA	£0.95
VP85	1	Electronic Buzer, 12v, 25MA	£0.95
VP86	1	TECASBOTY Components Pack, semiconductors, caps, wire, etc	£1.00
VP87	1	Telephone Pick-up Coil with 3.5mm jack plug	£1.25
VP88	1	Pillow Speaker with 3.5mm jack plug	£1.45
VP107	1	Piezo Buzzer, miniature, 12v	£1.25
VP108	1	Piezo Buzzer, miniature, 240v	£1.25
VP113	1	Coax Antenna Switch, 2 way	£4.50
VP114	1	Coax Antenna Switch, 3 way	£4.75
VP115	1	High Pass Filter/Suppressor, CB/TV	£0.50
VP116	1	Low Pass Filter, VHS/TV bsnd	£3.00
VP122	1	Precision Morse Key, fully adjustable	£1.85
VP144	4	100K Lin multi turn Pots, ideal vari. cap. tuning	£1.00
VP145	10	Assorted Pots, inc dual and switched types	£1.00
VP148	30	Presets, horizontal and vertical, mixed values	£1.00
VP174	5	DIL Switches, 1 and 2 way slide, 6 way SPST, assorted	£1.00
VP176	30	Fuses, 20mm and 1 1/4" glass, assorted values	£1.00

Pak No	Qty	Description	Price
		TOOLS.	
VP410	1	18 Pc Hex Wrench Keys. AF sizes in wallet	£1.50
VP411	1	16 Pc Hex Key Wrench Set. SAE and Metric	£2.00
VP412	1	Crimping Pliers, Wire Strippers & Bolt Cutters	£1.00
VP413	2	IC Extraction Tools, jaw width 18 and 29mm	£2.00
VP414	1	End Action Stripping Pliers. Adjustable jaws	£1.00
VP415	1	5" Grip Locking Pliers	£3.00
VP416	1	6" Long Nose Grip Locking Pliers	£3.00
VP417	1	6" Adjustable Wrench. Forged alloy steel	£2.50
VP418	1	8" Tin Snips. Hardened steel, spring joint	£2.00
VP419	2	"Chubby" Screwdrivers. Crosspoint No 1 and 2	£1.50
VP420	2	"Chubby" Screwdrivers. Flat blade 4.5 and 6mm	£1.50
VP421	1	Screwdriver 400mm long, 6mm flat blade	£3.00
VP422	1	Screwdriver 400mm long, No 2 crosspoint	£3.00
VP423	1	Vernier Caliper-Crosshorns. Depth gauge. Vernier Cap. 4 1/2"/110mm reading 1/128", 1/10mm	£2.50
VP424	1	Helping Hand with Magnifier	£4.50
VP425	1	7 Pc high quality Screwdriver Set	£8.50
VP426	1	7 Pc high quality Screwdriver Set 1000v	£12.50
VP427	1	6 Pc Cushion Grip Screwdriver Set	£4.00
		LEADS.	
VP300	1	10m Speaker Lead 2 pin DIN Plug to 2 pin DIN Skt	£1.00
VP301	1	2m Video Lead Coaxial Skt to Coaxial Skt + 2 adaptors	£1.20
VP302	1	3m 4 core cable indv. screned 5 pin DIN Plug-5 pin DIN Plug	£1.80
VP303	1	TV Ext. Lead. Coax plug to Coax Plug. White	£1.00
VP304	1	1.5m 4 core indv. screen. 5 pin DIN Plug-tinned open end	£1.00
VP305	1	1.5m cable 5 pin DIN Plug-3.5mm Jack Plug. Pin 1 & 4 connect	£1.00
VP306	1	2m Typewriter/Calculator Lead. 3 pin Plug, angled European IEC configuration. 6A 250vAC	£2.00
VP307	1	60cm Patch Lead. PL259 Plug to PL259 Plug	£1.00
VP308	1	1.2m Patch Lead. PL259 Plug to PL259 Plug	£1.50
VP309	1	1.2m Lead 4 Phono Plugs to 4 Phono Plugs	£1.50
VP310	1	20cm Lead 2 x 2 pin DIN Plug to Stereo Inline Jack Skt	£1.00
VP311	1	2m Lead Scart Plug to 5 pin DIN Plug & 2 BNC Plugs	£6.00
VP312	1	1.2m Video Lead. BNC Plug to Phono Plug	£1.50
VP313	1	3m Headphone Lead. 3.5mm Jack Plug to 3.5mm Jack Skt	£1.00
VP314	1	2m Coax Lead BNC Plug to BNC Plug. 75 ohms	£3.00
VP315	1	2m Coax Lead BNC Plug to UHF Plug. 75 ohms	£3.00
		TELEPHONE ACCESSORIES.	
VP316	1	5m Telephone Ext. Lead. Plug to Socket	£4.50
VP317	1	10m Telephone Ext. Lead. Plug to Socket	£6.00
VP318	1	3m Line Jack Cord. BT 4 way Plug to 4 Spade Terminals	£1.75
VP319	1	Double Adaptor. One IDC plug, 2 socket	£3.50
VP320	1	IDC Telephone Plug 4 way	£0.50
VP321	1	Telephone Master Socket Surface Box. Screw terminals	£3.50
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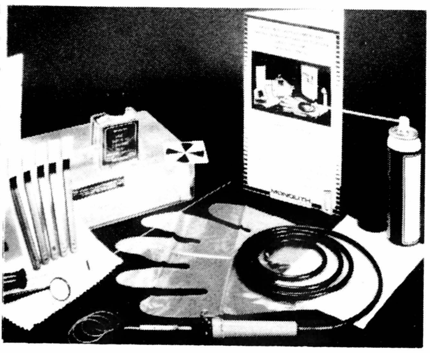

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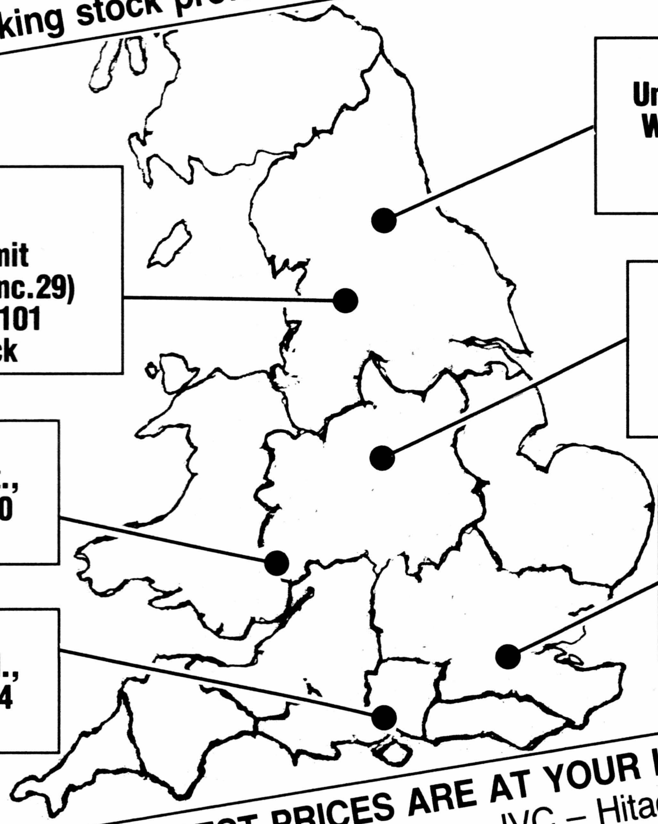

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NV600/688 IDLER	VXP0515	3.18
NV730 IDLER	VXP0581	3.18
NV777/778 IDLER	VXP0463	3.18
NV2000 SERIES IDLER	VXP0329	1.24
NV2000 (PLAY/TAKE UP)	VXP0331	1.24
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NV7000 (PLAY/TAKE UP)	VXP0343	5.76
NVG7/G10 IDLER	VXP0521	2.56
P. ROLLER NV333/366	VXP0432	8.51
P. ROLLER NV370	VXL1154	7.93
P. ROLLER BV730	VXL1209	7.58
P. ROLLER NV2000	VXP0330	10.66
P. ROLLER NV7000	VDP0759	2.56
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TENS. BAND NV370/730	VXZ0165	1.95
TENS. BAND NV2000/2020	VXZ0076	5.92
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REEL MOTOR NV333/366	MYN13V5L	15.03

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AN360	£1.30	AN7161	£3.75	HA1367	£3.25	LA1368	£2.50	LA7806	£2.75	STK2028	£7.50	TA7269P	£5.50	UPC1263C	£2.50
AN362L	£1.60	AN7166	£3.95	HA1368	£1.90	LA1385	£1.95	LA7808	£2.95	STK2029	£5.75	TA7270P	£2.75	UPC1277H	£2.75
AN363N	£3.50	AN7168	£2.75	HA1368R	£1.95	LA1387	£3.60	LA7820	£2/75	STK2038II	£9.50	TA7271P	£2.75	UPC1278H	£2.75
AN366P	£1.70	AN7178	£2.95	HA1370	£3.70	LA1460	£2.50	LA7910	£2.20	STK2125	£6.75	TA7272P	£2.95	UPC1363C	£2.75
AN374P	£2.20	AN7213	£1.95	HA1372	£3.50	LA1464	£3.20	LA7920	£1.75	STK2129	£6.75	TA7273P	£3.20	UPC1364C	£4.75
AN377	£2.00	AN7218	£1.75	HA1374	£2.50	LA2100	£2.95	LB1405	£2.20	STK2230	£6.50	TA7274P	£2.95	UPC1365C	£3.60
AN610P	£1.80	AN7222N	£3.50	HA1377	£2.20	LA2101	£3.30	LB1409	£2.95	STK2240	£9.50	TA7280P	£3.50	UPC1384C	£3.50
AN612	£1.80	AN7223	£3.95	HA1384	£3.95	LA3160	£1.50	LC4066B	£2.95	STK2250	£9.50	TA7281P	£2.95	UPC1387C	£2.50
AN5010	£4.75	AN7224	£3.50	HA1388	£3.50	LA3201	£0.95	LC7130	£3.50	STK3041	£6.50	TA7282AP	£2.95	UPC1391H	£1.50
AN5151N	£6.50	AN7256	£3.50	HA1389	£2.20	LA3210	£0.75	LC7131	£3.75	STK3042	£6.50	TA7283AP	£2.95	UPC1394C	£1.95
AN5265	£3.20	AN7273	£3.95	HA1389R	£2.20	LA3220	£2.95	LC7132	£4.00	STK3044	£5.95	TA7288P	£2.95	UPC2002	£0.80
AN5410	£5.50	AN7310	£1.20	HA1392	£2.50	LA3300	£1.65	LC7136	£3.75	STK3062III	£6.75	TA7299P	£2.95	UPC4558C	£0.90
AN5411	£3.50	AN7311	£1.20	HA1394	£2.95	LA3301	£1.30	LC7137	£4.50	STK4026	£5.75	TA7317P	£2.75	BC639	£0.22
AN5430	£2.95	AN7410	£3.00	HA1396	£3.75	LA3310	£2.75	LC7800	£3.95	STK4060	£6.50	TA7328P	£2.20	BC640	£0.22
AN5510	£2.75	AN7415	£2.95	HA1397	£2.75	LA3350	£1.30	M5134P	£3.25	STK4131II	£6.75	TA7343AP	£2.95	BFR90	£0.70
AN5512	£2.95	AN7420	£3.25	HA1398	£2.75	LA3361	£1.20	M5155P	£1.85	STK4141II	£7.50	TA7358P	£2.80	BFR91	£1.20
AN5612	£3.75	BA301	£0.80	HA1457W	£2.75	LA3370	£2.80	M51102L	£3.95	STK4151II	£7.50	TA7607AP	£2.95	BFY90	£0.50
AN5620X	£3.50	BA311	£0.95	HA11215W	£4.35	LA4030P	£2.00	M51104L	£3.95	STK4332	£5.75	TA7608CP	£3.95	BR303	£1.50
AN5701	£1.80	BA313	£0.80	HA11219	£3.25	LA4031P	£1.95	M51513	£1.80	STK4352	£6.50	TA7609P	£2.70	BRY56	£0.20
AN5722	£1.60	BA314	£2.20	HA11221	£2.75	LA4032P	£1.90	M51514	£1.95	STK4392	£7.50	TA7613AP	£2.75	BT106	£1.00
AN5730	£1.85	BA318	£1.50	HA11223W	£3.80	LA4100	£1.20	M51515BL	£2.50	STK4803	£8.50	TA7628P	£2.95	BU208A	£1.20
AN5732	£1.85	BA328	£2.50	HA11225	£1.95	LA4101	£1.00	M51516BL	£2.80	STK4833	£9.50	TA7640AP	£1.75	BU208D	£1.80
AN5750	£3.75	BA333	£1.50	HA11226	£4.50	LA4102	£1.40	M51517L	£2.80	STK4843	£8.95	TA7658P	£1.75	BU326A	£1.95
AN5753	£1.95	BA335	£3.60	HA11235	£2.30	LA4110	£1.75	M51518L	£2.20	STK5211	£6.75	TC9106BP	£4.95	BU500	£1.80
AN6250	£2.30	BA340	£2.50	HA11251	£2.75	LA4112	£1.75	M51521L	£1.90	STK5315	£6.75	TD62105P	£3.50	BU508A	£1.80
AN6326N	£3.70	BA343	£2.75	HA11401	£2.80	LA4120	£2.95	MB3705	£1.80	STK5324	£5.75	TDA1010A	£2.25	2N3055	£0.50
AN6327	£4.75	BA402	£0.95	HA11423	£4.75	LA4125	£2.20	MB3712	£1.50	STK5325	£6.75	TDA1011A	£2.50	2N3773	£1.50
AN6328	£4.20	BA403	£1.95	HA11440	£3.95	LA4126	£2.60	MB3713	£1.60	STK5421	£6.50	TDA1074A	£2.75	2SA733	£0.40
AN6330	£2.95	BA511A	£1.85	HA11701	£3.50	LA4137	£1.95	MB3714	£2.95	STK5451	£6.75	TDA1151	£1.20	2SA1104	£2.50
AN6340	£7.85	BA514	£1.90	HA11703	£4.50	LA4140	£0.90	MB3722	£3.50	STK5471	£6.50	TDA1170N	£1.50	2SA1106	£2.75
AN6341N	£4.00	BA516	£1.90	HA11704	£5.20	LA4145	£1.70	MB3730	£2.50	STK5476	£6.75	TDA1170S	£1.50	2SB536	£0.95
AN6342N	£2.50	BA521	£1.80	HA11705	£6.95	LA4160	£2.40	MB3731	£3.50	STK5720	£6.80	TDA1510	£4.50	2SB546A	£1.50
AN6344	£4.75	BA524	£2.75	HA11706	£4.75	LA4170	£3.50	MB3756	£2.60	STK5730	£4.25	TDA1515	£4.50	2SC461	£0.35
AN6350	£7.50	BA526	£3.50	HA11710	£3.75	LA4178	£2.50	MB3759	£2.30	STK7216	£6.50	TDA1515A	£4.50	2SC867A	£2.95
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AN6371	£4.25	BA612	£1.80	HA11718	£4.75	LA4230	£2.25	STK020	£5.75	STR440	£5.80	TDA2006	£1.50	2SC2581	£2.95
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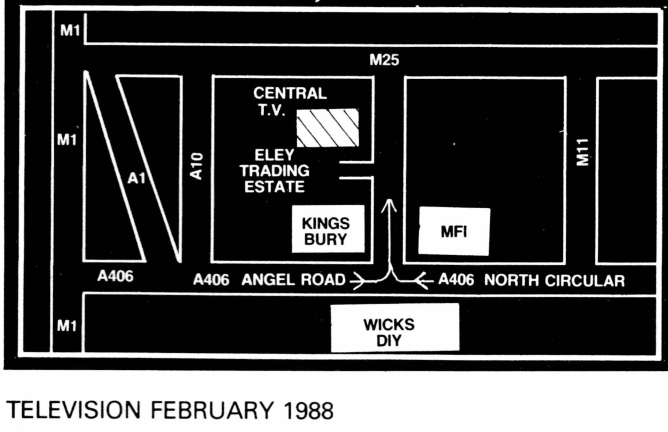

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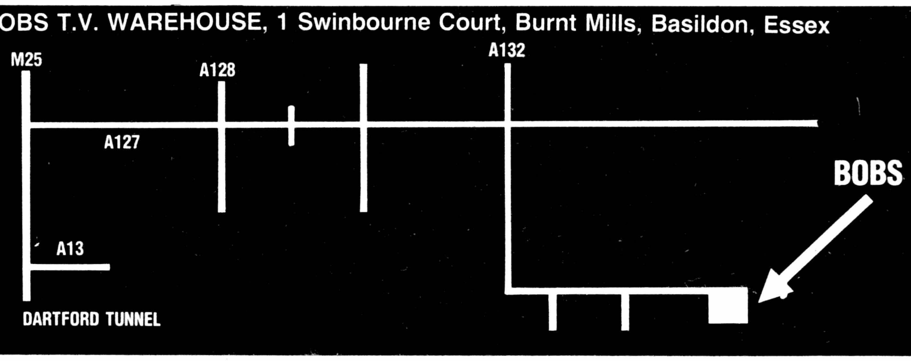

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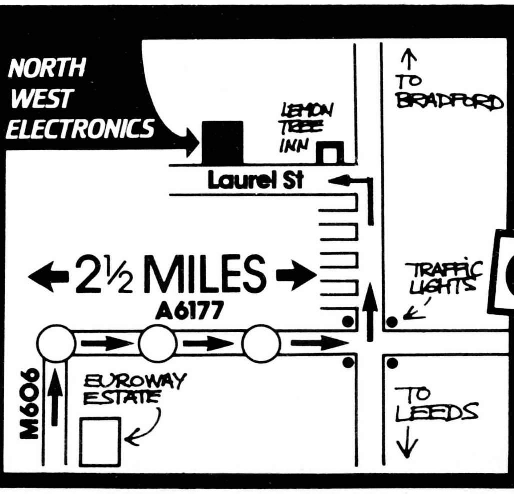

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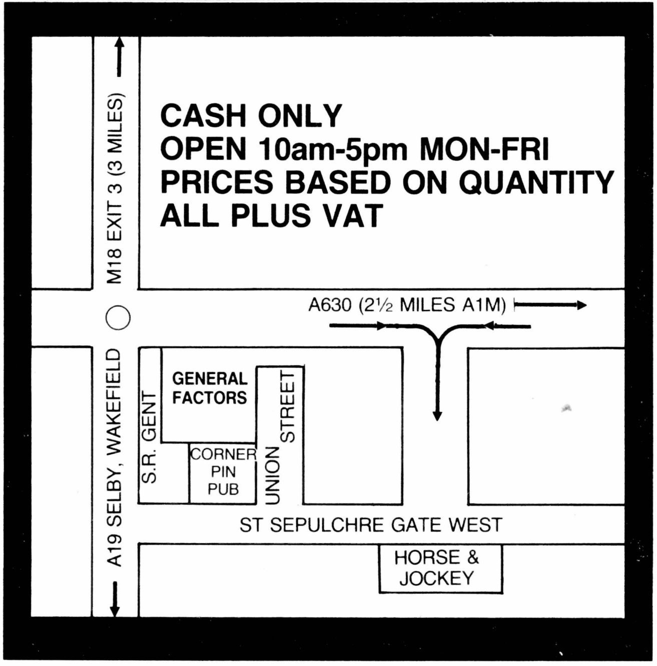

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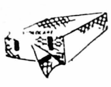

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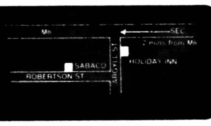

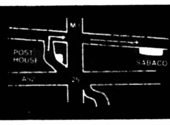

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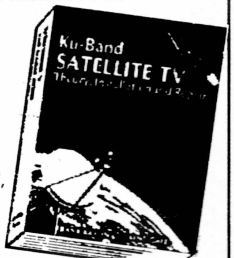

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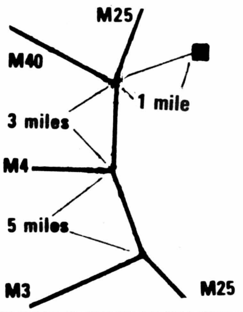

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15 Watt Stereo Amp Sanyo Module with Data	50p
PHILIPS	
25 Watt Solder Iron	£4.00

Various Tools and Accessories

T/V V/Aerial 300Ω or 75Ω	£1.50
L.C.D. clock display with alarm	75p
* D/P push mains switch	20p each
Mains lead & two pin socket for radio cassette	35p
T/V loop aerial	75p
Radio Telescopic Aerial	£1.00
Philips Neon Lamps for TV sets	5p
Freeze Philips	£1.20
Foam Cleaner Philips	£1.20
Contact Cleaner Philips	£1.20
Cans of Anti Static, Degrease Cleaner and Anti Corona	All at £1.40
Lorlin Full Remote Relay Switch fit most T/V sets, mains 4 tag, 2 tag 12 volt	£1.00
Mains timer. 13 amp — up to 2 hours: easy to use, plugs into socket	£3.00
Screen locking agent, large can	£1.50
Red E.H.T. LAED and Anode Cap	£1.00
Weller solder iron 15 watt/25 watt	£5.00
Hitachi Silver Oxide Battery G13 UCC357 IEC SR44 1.5V	60p
100 Coax Plugs	£12.00
De-solder pump + 2 nozzels Philips	£4.00
Flat Red LED and Green	5p
500gm 60/40 solder reel	£6
Solder 1 kilo reel	£5.50
Dual v/u meter -20 – +10db	£1
K30 thermistor 232266298009	75p
De-solder Pump	£2.50
Portasol Flameless Gas Soldering Iron	£16.00

KT3 PANELS

Sound Output RGB Output Chroma Panel, I.F. Panel and Line OSC	£7.00 each

SONY 1400KV Chroma Panel	£6
SONY 1400KV Touch button unit	£3.50
GEC Decoder Panel PC772A3 PC446A5	£6
Tube Base 20AX GEC PC852B3	£1
Thorn Aerial Socket TX10	£1
12 Volt Mains Trans 500M/A	£1.00

Quantity Reductions

BY204/4	25 for £1.00
BY206	25 for £1.00
KT3 touch button black	6 for £1
G11 touch button red	6 for £1
K30 full remote Dawer Ass with 3 I.C.	£7.00
K30 VHF. UHF Dawer Ass	£6.00
BY298 3 amp/fast/R	20 for £1.50
BU126	10 for £6.00
BU205	10 for £8.00
BU105	10 for £6.00
BF458	10 for £1.00
BF224	20 for £1.40
OA90	40 for £1.00
50 Ceramic Condensers	£1.50
Mixed Mounting Kit for Power Transistors	50p
300 Condensers	£1.50
300 Resistors	£1.50
150 Electrolytics	£2.00
15 Bulbs Philips	40p
GEC-Hitachi Thick Film Frame	£5

Plastic Boxes 4¾ × 4 × 1 × ¾	50p
100 Fuses	£2.00
100 W/W Res.	£1.50
BF 199	20 for £1
10 × 20 Turn 100k pots. Rank	£2
BF 470	20 for £2
6 Mixed UHF Aerial Isolating Sockets, some with long leads. Fit ITT, GEC, Philips, Pye	£1.00

Mixed Packs

TO66 12 Power Trans RCA 16182 NPN Replacement for BD124 and Mounting Kits	£1.00
25 Panel Mount Bulbs & Neons	£1.50
10A	£1.50
25 LED red/yellow/green	£1.50
20I/C Holders	£1.20
20 Large LED Red	£1.00
20 Small LED Red	£1.00
10×20 Turn 100K Pots	£1.00

Red & Green LED on Panel	1p each
Mixed 100 Transistor B.F. and B.C. and PET	£1.50 1000 for £10.00
12 Volt 4 Amp Video Battery Pack 10 of Type D Cells	£8.50

40 glass reed switch	£1
10 press to make switch	70p
40 Pots	£1.50
5 Tube Bases	£1.00
1,000 Diodes, Condensers, Resistors on Bandolier	£2.00
20mm Fuse Holders Chassis Mount	20 for £1
EHT Diodes, small	20 for £1
300 Mixed Diodes	£2

100 500M/A Fuse	£1
Mixed V/Cap Pots ITT-GEC-Hitachi-Philips etc,	20 for £1
ITT Mains Switch with Remont CMC113	£1

SENDZ COMPONENTS

TO ORDER SEE BACK PAGE

SENDZ COMPONENTS

TO ORDER SEE BACK PAGE

Matsushita PY34220 Tuner	£7
C. Cam Decoder with TDA3591	£5
Toshiba VHF/UHF EG522F	£6
Mitsumi MEC1-F51	£5

Thorn Spares

New 9000 Decoder	£8.50
9000 Frame panel	£8
9000 Cyclops panel	£1.50
8800 convergence panel	£6
8500 convergence panel	£6
4000 Power supply	£3
1600 Mains lead, switch	
T605 1vNPN T066 80v/6A	10p
9000 Sound output panel	£1
3500 Focus unit	£1.50
3500 Mains Trans	£4
3500 cut outs	10 for £4
3500 IF panel	£2
3500 Frame panel	£3
3500 Line panel	£3
3500 A1 Diode	20p
Export 3500 IF panel	£2
IC board with set of SN74LS	£1
4000 Tube base	£4
3500 A1 pots	50p
Beam limiter panel	£1.50
3500 Power panel with Y969	£1
3 Way regulated adaptor 240V 6V/7.5/9V/300mA	£3.50
Rank/Toshiba preh unit 0354	£9.50
4 Push button unit preh	£1.00
6 Push button VHF/UHF for v/cap. GEC-Decca type	£7.00
7 Push button for CVC5 ITT	£8.00
KT3 12 Push button unit	£2.00
KT3 (Export) 12 P.B.u	£2
6 Push button Unit Thorn	£1.00
6 Push button GRC	£6.00
6 Push button PYE 731	£6.00
Hearing aid unit	£3
Rank Z718 4 P/B/Unit MECH	£4
7 Button Unit GEC with Lamps	£7
697 Push Button Unit	£6.00
Z916B panel	£5.00
T513AP panel	£5.00

Mains Droppers

Pye 731 3+56+27R	50p
Thorn 50/17/1K5	£1.00
120/20/20/48/117	£1.00
270/10/6 for Thorn 4000	50p
18/320/70/39	£1.10
Thorn 50-40R-1K5	50p
Ae Socket & Lead	
GEC, ITT, Philips, Pye	25p
7×3¾ Thorn	£1
Thorn 1600-1700	£1.50
Rank Toshiba Tube Bases	30p

Speakers

6×4 G11	25 ohm	£1.00
5½×2½	3 ohm	£1.00
5×3	80 ohm	70p
5×3	50 ohm	50p
5×3	35 ohm	70p
6×4	15 ohm	£1.00
6×4 speaker	16 ohm	
7×3	70 ohm	£1.00
8×5	8 ohm 15 watt	£2
8×5	8 ohm	£1
5×3	8 ohm	70p
7×3	16 ohm	£1.00
5″ dia	16 ohm	£1.00
5″ dia	8 ohm	£1.50
6½″ dia	4 ohm	£1.50
6½″ dia	3 ohm	£1.50
2¾″ dia	8 ohm	75p
3″ dia	8 ohm	75p
4½″ sq.	15 ohm	75p
KT3 speaker	K30	75p
3″ dia	15 ohm	60p
1690 5×3	12 ohm	£1
K45 Philip	15 ohm	75p
K30 15 watt		£1

KT3-K30

OF-425		
OF-550	E.W. correction	10p
OF-513		10p
OF-557		50p

DIODES

BY 126	10p
BY 127	10p
BY 133	10p
BY 134	10p
BY 164	50p
BY 176	25p
BY 179	40p
BY 184	25p
BY 187	10p
BY 190	40p
BY 196	30p
BY 198	10p
BY 204/4	8p
BY 206	8p
BY 208/800	8p
BY 210/400	5p
BY 210/800	10p
BY 223	60p
BY 224/600: 4.8A/600v bridge	50p
BY 226	15p
BY 227	15p
BY 228 1500v	20p
Flat BY229 black	15p
BY 299 Red	20p
BY 229/400	30p
BY 299/60p Tag	30p
BY 237	5p
BY 254	10p
BY 255	30p
BY 298	10p
BY 299	10p
BY 406	8p
BY 527	20p
BY 407a	10p
BY 527	10p
BY 602	10p
F 247	10p
GP20G	5p
GRP80G (TX10)	60p
XK 3102	50p
BYV 28/200	20p
800v/2.75 amps	10p

K35 Decoder	£8.00
K35 Sound OP	£4.00
K35 Split Diode 3122-138-35930	£10.00
Thick Film Daughter KT3 3122-127-43891	£3
12 C.H. K30 Tex Rec Front Panel with I.C.	£5
K35 IF	£5.00

Plug In

K4 Focus Pot	£1.00

Fidelity Tube Base with transitor & focus pot	£1.50

Bush Tube Base on panel	£1.00

TX10 Tube Base on Panel	£3.00

Line Transformers

Line O.P. Trans. Mono T.X. 12″-14″	
Philips	
27482	£10
4822	£10
10273	£10
Thorn 1690 LOPT	£7.50
2 J/Pots 3,500 1 off each type	£3.00
G8 Trans. Philips	£7.00
G11 Split Diode	£12.00
CVC820 Split Diode ITT	£10.00
Thorn B/W AD5308F + Stik + Lead	£1.50
GEC 2040	£3.00
GEC 2110	£7.00
Mullard AT 2036	£1.50
Pye 169 Line Trans	£3.00
Pye mono	£3.00
Rank mono T704A	£3.50
Split Diode Trans	£7.00
GEC 20 AX Rank Z522	£3.00
Rank L.O.P.T. Z970	£3.00
CVC32	£6.00
AT2080/15	£5.00
CVC30 ITT	£5.00
CVC32 Line Tran	£7.00
CVC800 Line Trans	£6.00
CVC40 Slip/Diode	£12.00
CVC 45	£5.00
GEC Portable G1OT2041	£3.00
GEC Portable G1OT2046	£3.00
EHT Split Diode Leads ITT	£1.00
3500 L.O.P.T. & HT Trans	each £2.00
LOPT Rank Z763	£5.00
K35 Split Diode 3122/13835930	£10.00

Black Triplers

KT3 Triplers	£6.00
S.T.C. Universal Tripler	£6.00
11 TJT	£2.50
11 TGA	£2.00
ITT CVC 5-8-9	£3.50
Rank T25LE Tripler	£2.00
Rank 11TCP A823	£3.50
TU 25 30K Rank	£3.00
11 TEZ Rank	£3.00
G9 Philips	£4.00
GEC 2110	£4.00
3500 Thorn	£3.00
8500 Thorn	£4.00
9000 Thorn	£7.00
9500 Thorn	£4.50
9600 Thorn	£4.00
2040 GEC	£3.50
GEC TVM25 Tripler	£2.00
Universal Tripler	£5.00
G8 Tripler	£5.00
CVC20-32	£5.00
Decca 80 100	£4.50
Grundig TVK 52	£2.50
11TBQ Pye 731	£3.00
11THY	£4.00
D22 for Pye 18″ colour portable	£4.00
LP 1193/63	£4.00
BG 100/41	£3.25
ERO Tripler print type with foacs PO7 BG2087	£5
T/text ultrasonic rec'r panel	£14.00
12-14V. 20 for £5.00	200 for £25.00
GEC 8 touch unit assy complete with all I.C.'s + pots	£4.00
G11 E.W. Transformer	50p
G11 E.W. coils	£1.00
G11 Transient Suppressors 245V	20p
G11 Scan Coils	£5.00
G11 100K tuner pots	12 for £1
KT3 IF panel	£6.00
KT3 line OSC transformer	£1
KT3/K30 infra-red receiver head	£1
K30 drawer unit with IC's (home)	£10
K30 drawer unit with IC's (export)	£10
KT3 AE Sockets	50p
KT3 receiver panel	£8
KT3 line driver transformer	50p
Pye, K30, GEC, etc. Pre-mains stand-by switch	£1
Decca 80/100 IF panel	£5
NPN PNP 80V 6 Amp TO66 O.P. Trans.	pair 25p
5 button touch tuner BBC1/2 ITV1/2 video with ic SAS 560T/570T	£7.00
Control panel 5 sliders + mains lead	£1.50
G11 8 touch button unit replaces old 6 P.B.U.	£24
Tube base + base unit for 820 Euro chassis	£4.00
GEC Line O/P Trans. & Rec Stick for Portable	£3.00
CVC 20/25/30/35/40 decoder panel	£10
CVC 20/25/30/35/40 decoder panel (untested)	£5
CVC 40/45 IF panel	£5
40K Transducer	50p
PHILIPS NE511N	£1.20
LM337M Reg.	30p
20 GEC Black Spark Gaps	£1.00
KT3 Front Panel Control Assy.	£2.50
BTW 30/50	50p

International Rectifier EHT Diodes G770/HV34 6KV	3 for 8p
6A/600V Stud Diodes	20p
6A/1000V Stud Diodes	20p
BTW 92/800R	£3
25A473 PNP C/P	10p

25% OFF ALL PANELS

Rank T20 Z136 Panel	£6.00
NEW GEC 20AX Power Supply Switch Mode	£12.00
Field + Jungle panel for GEC 3133/3135	£1.50
GEC 2110 line panel with transformer	£7.00
GEC 2110 tuner unit + IF Panel	£12.00
Pye/Chelsea Line op panel	£12.00
Pye 205 T/unit	£3.90
Pye 205 Line op panel	£7.50
Pye 713 IF panel and tuner	£7.00
Pye 713 Chroma	£10.00
Pye/Chelsea Timebase panel with LOPTI	£10.00
Pye 731 Frame Panel	£5.00
Pye 731 Convergence Panel	£5.00
Pye 731 Chroma	£10.00
Pye 731 IF panel + tuner	£10.00
Pye CDA/205 panel	£6.00
GEC portable chassis + LOPTI 2114 New	£4.00
Thorn 1613/1713 chassis	9.75
G9 Power Panel	£6.00
Mono RANK Chassis 127A NEW	£10.00
NEW G9 Frame Panel	£4.00
NEW G11 IF Panel	£10.00

G8 Tuner Unit + Panel	£4.00
G8 IF & Chroma	£6.00
G8 Chroma	£3.00

G11 IF Detector	£3.00
G11 Selector gain module	£3
Complete CVC 825 Chassis (both panels)	£40.00
AEC V/Cap Resistor Unit UHF with IC SAS660 SAS670	£3.00
Z714 RANK IF Panels 6MHz 1 I.C. SL437F	£3.00
Z909B RANK IF Panels Export 5.5MHz 2 I.C.'s TBA1205B TCA2705Q	£2.50
K35 IF	£6.00
Z743 RANK IF Panel Export 5.5MHz 3 I.C.'s TBA750+SC9504P+ SC9503P	£1.50
Pye G11 Front panel with transducer, pots, tuner pots, 6 pb switch+lead	£5.00
Pye 6 button switch portable	£1.00
GEC V/cap VHF/UHF tuner and IF+ sound O/P PC 706B3 (Export)	£12.00
GEC Line O/P PC 659B3	£6.00
2110 GEC Power Panel	£8.00
CVC 20 Front panel with sliders + mains input panel	£4
CVC 40 PUSH BUTTON ASSY with sliders: complete with lamp assy + pots 8 button units	£9.00
CVC9 slider pots panel	50p
CVC 5 Mains on/off + 5 pots	£2
Universal Focus. Fits Pye, Thorn and Decca Units.	
T147 Rank tube base on panel	£1.00
Z718 Focus Unit	£1.50
T20 Focus Unit	£1.00
Large Type	75p
Decca Small	75p
KT3 Focus Unit	75p
K30 Focus Pot	75p
K30 Tube base on panel	£1.00
TX10 Focus Units	£8.50
CVC 32 Focus Unit	75p
Fedility Focus Unit 14R–14S	30p
3500 Thorn Focus Unit	£1.00
ITT Small for use with Split	
Z718 Bush Focus	£2.00
Diode	50p
TV11	50p
Remo TV12SP	50p
1600 Thorn EHT Rec and Lead	50p
TV13	50p
TV14	50p
TV18	60p
TV20	£1.00
TV45	50p
Thorn 14/1500 rec stick	5p

TX10 8 Button Unit	£10.00

TX10/TX100 16 Button	£10.00

G11 drawer ASS 3 pots Mains switch and lead	£2.00

K30 Drawer Ass with pots cable forme	£1.00

TX10 Drawer with 8 way pots. ass.	£2.50

TX10 Ex. port with band switch (drawer)	£2.50

Line O/P panel GEC 2217/2218/2213/2214/2226/2227/2228	£10

PHILIPS BATTERIES (Small Types) HAND SETS

SR41	40p
SR43	40p
SR44	40p
SR54	40p
LR43	40p
LR44	40p
LR54	40p
CR2032	40p

10 500PF 2KV	20p
.22/1000	20p
.1/250AC	20p
.1/100	5p
1MFD-250AC	25p
1/100 × 10	30p
22/100	10p
4.7M/100	5p
470/100	20p
4700/100	75p
47/160	10p
300 300/300V	80p
800/160	50p
.1/250 Pulse	5p
2,2 250v	10p
7N5 1500V	15p
3n3/250 A.C.	10p
.33/250V	20p
.39/250V	15p
4n7/250 tested 5KV	25p
22/250	15p
47/250	10p
100/250	20p
G11 470/250V	£1.75
GEC600/250	60p
700/250	£1
300+300 MFD 350v	£1.00
800/250	40p
32/300	20p
4/350	5p
8/350	8p
4.7M/350v	10p
33/350	20p
220/350	30p
300/350	40p
400/350	50p
22/375	15p
220/385 (ITT)	75p
330/385 CVC 820HT	60p
0.1/400	15p
KT3 E/W .39/400	15p
.56K/400v	20p
4700pf/400	10p
.22/400	10p
8/400	15p
33/400	20p
400/400	40p
394K/400V	20p
220/450	40p
.47/500	25p
0.1/600	15p
0.1/1200V wire end	20p
0.1/450 A/C wire end	20p
.22/1000	20p
.047/600	15p
0.047/1000	10p
0.01/1000	10p
0.1/1000	10p
.47/1000v	65p
.47/250V A.C.	10p
.001K/1250	10p
0.0047/1500	10p
.005/1500	10p
.0105/1500	10p
1n8/1500	15p
2n0/1500	10p
2n2/1500	15p
.01/1600	15p
G11.8200/2KV	15p
0.1/2KV	20p
3n9/2KV	15p
0.0015/2KV	10p
6n2/2KV	15p
2n0/2KV	15p
2n2/2KV	15p
470pf 4KV	10p
7500pf/2KV	10p
3000PF/3000V	10p
4n7/2KV	15p
6n2/2KV	10p
7n1/1500V	10p
8n2/1500V	10p
9n1/2000V	10p
8n2/2KV	15p
0.0082/2500	15p
150/3500	10p
1800/4KV	5p
4.7nf/5KV	10p
170/8KV	10p
180/8KV	10p
210/8KV	10p
1000/10KV	10p
.47/100V	80p

CVC 20-25-30 Mains Switches	60p
Infra Red and Ultrasonic G11 Teletext Decoder Panel	£30
RANK & ITT Mains Remote On-Off Switch (720R)	£1.50
RANK & ITT Remote Switch 2800 ohm	£1.50
G11 Mains Switch	50p
4 amp Mains Switch	25p
GEC Mains Switch 4 amp	30p
KT3 Mainswitch	£1.00
G8 Mains Switch	75p
G11 Preh Red LED P/Button for C.H. Change	20p
RANK TOSHIBA Transductors TPC-2011	50p
Mains Switch ITT Long Type Print	75p
Mains Switch Philip Long Type TAG	75p
Mains Switch GEC Long Type TAG	75p
2000 Chassis Fidelity Mains Switch (4 TAG)	60p
250V/4A White Lorlin Mains Switch	60p
KT3-K30-K35 Full Remote Mains Switch (6 TAG)	£1
Teletext Adaptor Kit TY-500 Panasonic	£12

Tube Thermpath 167	£1.00
Rank Secam Decoder Panel UHF & VHF T115A	£13.00
10 off .91 CAP G11	£2.00
Philips K4 CAP 150M/385V	50p

Multi-Caps

220 MFD Sprague 385V	50p
350V 300M + 300M	£1.00
400V 400M	60p
350V 400M	60p
Thorn 3500	
175/100/100/350v	£1.00
KT3/200/25/25/385v	£1.00
KT3-K30 220+40+40	75p
200+200+75+25M 325V	£1.00
300+300+150+100+50MFD 350V	£2.00
G11 CAP 470/250	£2.50
47/220/350v	60p
150/150/100/100/100/320v	£2.00
2500/2500/63v	50p
150/200/200/300v	70p
300/100/100/16/275v	£1.50
100/200/325v	40p
150/150/100/375v	£1.50
200/200/75/25M 375V	£1.00
Thorn TX9 Caps 500+500M 175V	£1.75
300/300/100/32/32/300v	2.00
1500/2000/30v	50p
150/150/100/100/320v	£2.00
100/350 + 300/200/100/16/275v	£2.00
225+25/380 GEC	70p
200/100/100/350v	£1.50
500/500/25v	50p
150/150/100/300v	75p
200/150/150/300v	1.00

ITT 8 and 6 Push Button	£1.00
Pye 725 LOPTs	£6.00
Pye 731 LOPTs	£6.00
Thorn 8500-8800 LOPTs	£5.00

CMC 301 front panel	£8.00
CMC 303 front panel	£8.00
CMC 302 Panel with TC mains switch etc	£8.00
CMD 800 Decoder	£8.00
UPC 574	30p
BSS 38	30p

G11	£1.50
1 I.C. Receiver Panel	
3 I.C. Power Supply G11 Full Remote Receiver Panel	£3.00
FET Power VN88AF	50p
PHILIPS SBC 469 Stereo Microphone	£23.00
Meters Hills 520	£17.00
Meters Hills 420	£15.00
Hills HD5000 Digital Meter 1000V DC 750AC 10 Amp 20 MRG Rangers	£28
HT100 Multimeter	£6.75
HT300 Multimeter	£7.75
HT500 Multimeter	£9.00
HD1000 Digital	£20.00
HD3000 Digital	£25.00
HD5000 Digital	£25.00
HD6000 Digital	£32.00
HD8000 Digital	£37.00
HD9500 Digital with capacity of Temp Volts Ohms and Amps ranges	£60

Infra Red Hanset Tester

Works at 24 feet – Sound repeater. Works off 9 volt battery Fits in top pocket.	£8.00
Handset Tester with LED	£4.50

Repaired Handsets

Philips K4-K35, RC5350-RC5300, RC5370, RC5375, repaired same day	£10.00

RC4001 Full Remote KT3 K30 Teletext Handsets exchanged	£15.00

GEC Full Remote Infra-red, 1983 models	£15.00

Timers, 60 mins, small	£1.00

TOSHIBA HAND SETS

24 Button CT938 Fuliremote	£5.00
32 Button CT983 Videotext	£6.00

THORN

VCR Front Display Panel	£7.00

Large type ITT TV and V.C.R. Handset	£15.00

GEC Ultrasonic 8CH Full Remote	£15.00

G11 Full Remote Ultrasonic	£32.00
G11 Ultrasonic Teletext Handset	£20.00
8 C.H. Ultrasonic GEC Full Remote C2014H/C2219H	£15.00
New Replacement for G11 Ultrasonic Full Remote	£12.00
Thorn 4000 insert with 7 buttons	£5.00
Decca RC 11	£14.00
Decca RC 12	£14.00
G11 Infra-red full teletext	£24.00
Dynatron-Full remote CTV 62, 63, 64	£19.00
Hitachi infra red handset	£18.00
Philips full remote KT3, 16C928/20C934; 7228/7324; K12 26C 797/1ST 66K 1826	£12.00
G11, Full remote top button assy.	£12.00
G11, Full remote repair service (exchange unit)	£18.00
G11, Full remote new ultrasonic	£32.00
GEC infra red full remote 8 channel (I.C.SAA1250)	£14.00
Philips infra red full remote 9 channel for 60 CP2605	£6.00
Philips infra red full remote 12 channel for 60 CP2605	£12.00
K35	
KT3/K30 T/Text	£15.00
KT3/K30 Full remote	£15.00
KT3 Power supply	£4.00
GEC infra-red 2236-2026	£4.00
GEC 8 button full remote	£14.00
GEC push pad handset button blobs	10p **each**
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BF197	**12p**
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BF199	**10p**
BF200	**20p**
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BF224	**15p**
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BF245b	**20p**
BF255	**20p**
BF256	**20p**
BF257	**20p**
BF258	**25p**
BF262	**15p**
BF263p	**25p**
BF264	**15p**
BF271	**10p**
BF273	**10p**
BF274	**10p**
BF324	**25p**
BF337	**50p**
BF355	**30p**
BF362	**20p**
BF363	**15p**
BF367	**15p**
BF391	**15p**
BF394	**10p**
BF419	**30p**
BF422	**15p**
BF423	**15p**
BF448	**30p**
BF470	**30p**
BF471	**30p**
BF694	**10p**
BF757	**30p**
BF758	**30p**
BF760	**30p**
BF761	**30p**

BF694	**10p**
BF758	**30p**
BF760	**30p**
BFT34	**15p**
BFT43	**10p**
BFT84	**8p**
BFW11	**20p**
BFX29	**30p**
BFX84	**25p**
BFY50	**15p**
BFY52	**20p**
BFY90	**25p**
BLY49	**25p**
BPW41	**25p**
BRC116	**25p**
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